How Does Ageing Affect Saving and Growth?

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ABSTRACT

This thesis investigates empirically how population ageing affects savings and economic growth by estimating six continuous yearly panel data as well as cross-sectional data. Fraction of aged population gives a negative impact whereas life expectancy gives a positive impact on savings, which is still true when entering them into the model together in the non-poor country sample. The former supports the life-cycle hypothesis whereas the latter supports our conventional wisdom. The empirical evidence indicates that ageing has a significantly positive impact on economic growth. Since extension in longevity enhances savings and there is a positive linkage between savings and economic growth, ageing exerts a positive impact on economic growth via savings. It is also found that initial condition of the economy has a significant diminishing negative impact on growth, which is negatively related to government consumption and political instability.

摘要

本論文透過數據分析，來探討人口老化對儲蓄及經濟增長的影響．研究數據主要分爲兩種：一．連續六年的横向及縱向國家數據(Panel Data)；二．横向國家數據(Cross-sectional Data)．壽命的延長對儲蓄有著正面的影響，而年長人口比例對儲蓄側有著負面的影響．在非貧窮國家樣本中，當這兩個變數同時進入模型時，這一正一負的關係仍然得以保留．前者支持我們的傳統想法，而後者則支持「生命循環假設」．我們的數據分析顯示，人口老化對經濟增長帶著正面的影響．原因是壽命的延長和儲蓄有正面的關係，而儲蓄和經濟的增長亦有著正面的關係，因此人口老化能透過儲蓄而對經濟增長帶出正面的影響．此外，本文亦發現經濟起初條件對經濟增長帶著有效漸退的負面影響．而經濟增長跟政府消費和政治不隱定則有負面的影響．

CONTENTS

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CHAPTER 1
INTRODUCTION

Populations are ageing around the world, especially in the industrialized countries, due to the declining in both fertility and mortality rates. An increase in life expectancy at birth and an increase in the fraction of population aged 65 or over are the characteristics of population ageing. From the view of historical factor, the dramatic shifts in fertility which took place after World War II have led to a rapid increase in the rate of population ageing. At the same time, the emergence of a superior technology for health augmentation and maintenance in the course of the 20^{th} century could therefore have led to a higher rate of growth of life expectancy for older relative to younger age groups. Hence, the rapid development of health care reinforces the rate of population ageing.

Table 1.1 is extracted from Weil (1997) which shows the age structure of the population for the world as a whole, for 24 countries of the OECD, and for the United States. It can be seen that the fraction of the population that is under 20 is decreasing and the fraction of the population that is over 65 is increasing. The fraction of the population over age 65 is expected to increase further as the baby boom generation fully ages past 65. In particular, the developed countries, like the U.S. and members of OECD, the fractions of the population over age 65 are expected to increase from 12.8 percent and 12.2 percent in 1990 to 18.6 percent and 17.2 percent in 2025, respectively.

These demographic changes have important macroeconomic effects. Firstly, the economy can be affected from the change in composition of the labor force and its participation rate. A shrinking labor force and an increasing share of older workers in the labor force would affect the productivity. An older population will have fewer workers per person and hence the population will have lower output per person. For instance, in Japan, participation rates for men aged 65-69 and aged 70 and over were 65.5 percent and 26.6 percent, respectively, which were relatively high by international standards[1]. At the same time, the number of early retirements in Japan increased. The labor force participation rate of men aged 60-64 declined from 81 percent in 1960 to 71 percent in 1988. One of the major reasons is that improvements in pension benefits have stimulated retirement (for details, see Seike 1993).

Second is the change in consumption pattern due to the demographic changes that exert a direct effect on the economy. The elderly consume more medical services and less private transportation relative to the young. The economy should accommodate a change in the pattern of consumption through a normally functioning market. However, some local or state governments in the U.S. give substantial support to the elderly through the tax-and-transfer system such as Social Security. The change in consumption pattern is not adjusted by the market mechanism, but rather from taxation and subsidized spending. There may not only be deadweight losses from this system, but also an ageing population will require increasing taxation, which may strain the political consensus underlying the programs.

Moreover, one of the social security systems is called "Pay-as-you-go" (PAYG), which means that the working group will contribute to the system while the retired elderly will receive the benefits of the system. When the fraction of ageing population is increasing, the burden of the working group to financing the system

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[1]According to Table 3.2 in Naohiro Yashiro and Akiko Sato Oishi's paper which is edited in The Economic Effects of Ageing in the United States and Japan (1997).

would be increased. There are several studies (e.g. OECD, 1988; Zhang, 1995; Ehrlich and Lui, 1998; Zhang and Zhang, 1999) examining the impact of social security on the economic growth. It is found that the old-age social security has a significant impact on the economic growth. As the fraction of ageing population is the major determinant of the old-age social security, it is believed that ageing should have a significant impact on the economic growth as well. However, in this research, the impact of ageing on Social Security will not be examined independently.

Thirdly, the economy will be affected by the change in human capital investment. Since the fertility rate is declining around the world, parents' human capital investment on their children is expected to increase, given the trade-off between the quality and quantity of children. On the other hand, if we expect ourselves to live longer, the consumption and savings pattern would be shifted. During the young and productive time, it is expected to consume less and save more for the old age consumption. Theory and empirical findings (Ehrenberg and Smith 1997, Ch.9) both show that there is a positive correlation with the investment in human capital (including, level of education attainment and on-the-job training) and the earnings. In order to increase the earning opportunity and hence to have sufficient savings for the old-age support, there is no doubt that human capital investment should be increased. Furthermore, because of the increase of life expectancy, the opportunity of acquiring human capital would increase. As ageing affects the investment in human capital and human capital is the engine of growth, ageing should therefore have an impact on growth.

Finally, the economy will be affected by the change in savings behavior. The life-cycle hypothesis states that the working population saves and the retired population dissaves; therefore, the older population will have a lower savings rate, given the population of working group is fixed. Besides, if young children and the old in a household are assumed to consume more than they contribute to household income, the higher of the dependency ratios which combines the young-age dependency ratio and the old-age dependency ratio implies a lower savings rate, given the same level of household income. As indicated in the economic survey on Japan 1989/1990 by OECD (1990), the current household savings rate in Japan will fall by more than one-half in response to the projected doubling of the old-age dependency ratio. The survey is based on a cross-sectional analysis of the relationship between the rate of household savings and the old-age dependency ratio in OECD countries in the 1980s. Because the high level of household savings in Japan has been considered one of the major sources of Japan's high economic growth, the falling savings rate may become a major constraint on its economic growth.

However, conventional wisdom tells us that if one expects to have a longer life, he/she is supposed to save more during his/her working age so that he/she can live comfortably after retirement. This elderly group often holds a substantial wealth during their retirement. According to Hurd's (1990) calculation on the elderly wealth holdings, it is found that the elderly hold about 35% of the net property and financial wealth of the households. In practice, the elderly would not use up all their wealth before they die as required by life-cycle hypothesis. One of the reasons is the existence of a bequest motive for savings. There is substantial evidence given by Kotlikoff and Summers (1981) that bequests are an important component of wealth accumulation. Therefore, estimated from the macro-level, the domestic savings rate does not necessary decline with ageing population. It will be interesting to see the impact of ageing on the domestic savings rate with different estimation methods on different data sets.

This research will focus on the issues of how domestic savings rates and economic growth will be affected by population ageing. Two main data sets will be employed: one from World Bank (1995) and one from Barro (1989). For the World Bank data, as they are in the form of panel data, a pooling technique will be used so as to pool time series and cross-sectional data. For the Barro's cross-sectional data, ordinary least square estimation method will be used broadly. Model settings in both panel data analysis and cross-sectional data analysis mainly follow the regression models in Barro (1991) and Barro and Sala-i-Martin (1995). Therefore, the basic results can be compared with those in their studies.

The rest of the paper is organized as follows: in Chapter 2, background of population ageing in selected countries will be discussed in details. In Chapter 3, literature review for the previous studies related to the issue of population ageing, savings and growth are provided. In Chapter 4 on empirical specification and data, the basic models used in this research for savings and economic growth will be presented. Expectations of variables in savings equation and growth equation will also be discussed in this chapter. In addition, different specifications in two different data analyses (panel and cross-sectional data) will be discussed. The pros and cons of using the above data sets in estimating the effects of demographic change will be mentioned as well. Chapter 5 includes discussion and analysis of the estimation results from the above two data analyses and a comparison of those results. Finally, conclusion and the contributions of this thesis will be given in Chapter 6.

CHAPTER 2

BACKGROUND OF AGEING IN SELECTED COUNTRIES

Demographic facts of the population ageing will be discussed here. All the figures used in this chapter are from United Nations (1999). Data from 1950-1995 are the estimates, while data from 1995-2050 are the medium variant projections. The general demographic trend of the world and the selected regions will be presented first and then the age structure changes of the selected countries including Germany, the United States, Japan, Singapore and Hong Kong will be discussed thoroughly. The first three selected countries belong to industrialized countries and they have been possessing large portion of older persons. Among Asian countries in 1980, Hong Kong has the second largest number of population percentage of people aged 65 or over. It is projected to remain at the second in the next several decades while Singapore will catch up with other Asian regions and will be the third greatest percentage of aged population by the year 2025.

A. Demographic Facts: World, More Developed and Less Developed Regions

Figure 1 shows the young (persons aged less than 15 years) and the old (those aged 65 or above) dependency ratio of the world population. The fraction of young population has a downward trend while the fraction of old population has an upward trend over time. As a result of baby boom after World War II, the portion of young aged group rises from 1950 and reaches a peak in 1970s but goes down afterwards. For the world as a whole, the proportion of old people will increase from 10.5 to 23.8 per cent between 1995 and 2050, while the proportion of young people will decrease from 50.2 to 31 per cent.

Throughout the period of 1950-2050, more developed regions always possess greater portion of aged population with smaller portion of young population than that in the less developed regions (Figure 2). In 1995, old-age dependency ratio is two-third of the young-age dependency ratio in more developed regions. In 2013, the number of older persons will exceed that of children for the first time. By the year 2050, there will be more than one and a half as many older persons as children. If the range of the old-age group is re-defined as people age 60 or above instead, the curve for the fraction of old-age group has intersected with the curve for the fraction of young-age group in 1998. Besides, there will be more than twice as many older persons as children by the year 2050.

Figure 1: Dependency Ratios by Major Area: Estimates 1950-1995 and Medium Variant 1995-2045

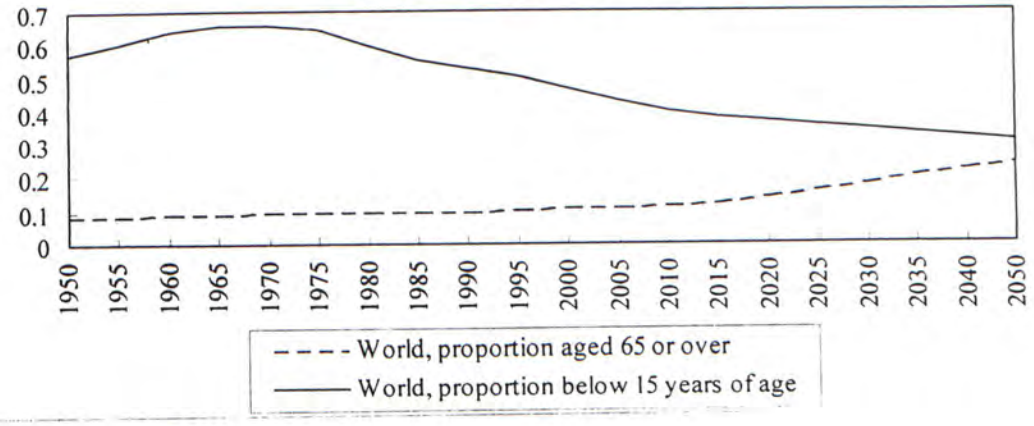
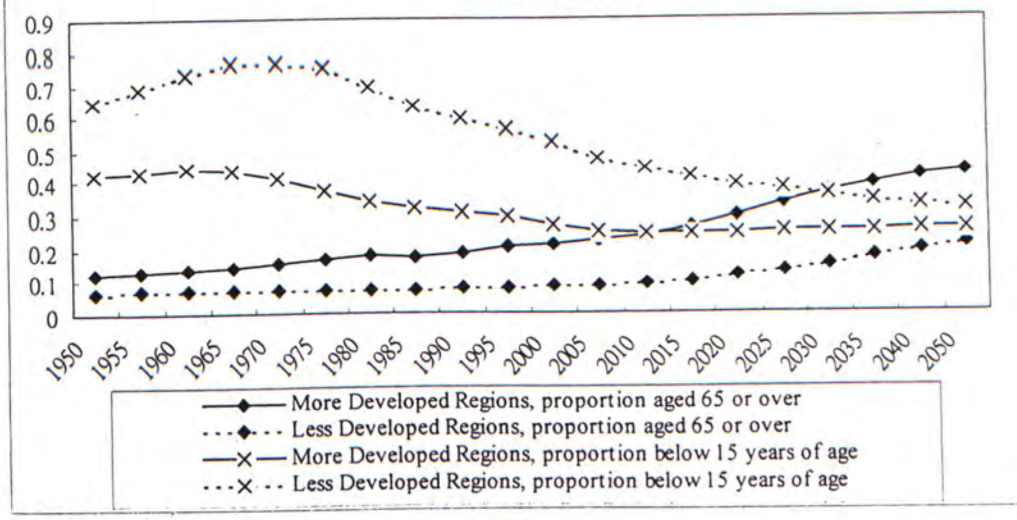


Figure 2: Proportion of Total Population Aged 0-14 Years and 65 Years or Over, More and Less Developed Regions, Estimates 1950-1995 and Medium Variant 1995-2045



B. Demographic Facts: Germany, U.S., Japan, Singapore and Hong Kong

The expected change in the age structure of the industrialized countries is dramatic and will lead to a substantially higher proportion of older people. Population ageing is particularly pronounced in Germany (see Figure 3). Among the three selected industrialized countries, Germany has the highest level of old-age dependency ratio before 1990s. It will increase from 0.155 to 0.284 between 1995 and 2050. However, it is projected that Japan's old age dependency ratio will catch up with Germany in 2000. It is expected to rise more than double from 0.146 in 1995 to 0.318 in 2050. Comparatively, the fraction of aged population in U.S. is quite modest. From now to 2050, the level of old-age dependency ratio will increase by about 1.7 fold and its rate of acceleration is quite moderate relative to the other two industrialized countries.

Among Asian regions, Singapore has a relative low level of old-age dependency ratio and it still holds even in the next decade. However, starting from about the year 2015, the fraction of aged population is projected to increase dramatically. There are 25.6 per cent of aged population in 2050 which is four times that in 1995 (6.3 per cent only). Being the second largest fraction of aged population region, Hong Kong has the similar path as in Singapore. The proportion of older persons in Hong Kong is also expected to rise rapidly after the year 2015. It is projected that the percentage of aged population will be increased by 3.4 times in 2050 with about one-third of the total population from less than 10 per cent in 1995.

Two major factors reinforcing population ageing are declining fertility rate and extension of life expectancy. Nowadays, there are many countries experiencing the demographic transition, which is a shift from high to low levels of fertility and mortality, and changing the age structure of a population from a young-age to an old-age distribution. Fertility decline reduces the proportion of children, and mortality decline raises the likelihood to survive up to old ages.

In order to understand how the above two factors work on the population ageing, we will look at Figure 4 and 5 together, which represent the total fertility rate and the total life expectancy of the selected countries respectively. As shown in Figure 4, the total fertility rate of the five selected countries seems to converge below the generation replacement level, which is 2.1, since the middle of 1980s. Germany has the lowest fertility rate (2.16) in 1950, which has been already around the replacement level, among the selected countries and its fertility rate rises up to 2.49 after 10 years and then drops again to the lowest rate 1.3 in 90s. At the same time, given the low level of fertility rate, the life expectancy of Germany has been increasing by 10 years from 67.5 years in 1950 to 77.2 years in 1995 and it is projected to be over 80 in 2025. The term "double ageing" is commonly used as describing the effects of both processes towards ageing.

Double ageing has been widely working on most of the industrialized countries including the United States. From 1950 to 1995, life expectancy at birth increases by about 11.2 percent in the U.S., while fertility declined to below the replacement level. Similarly, in Japan, life expectancy of Japanese has already reached 80 years in 1995, about 25 percent increase from 1950. Since 1975, the fertility rate in Japan has decreased to 1.81 and further to 1.43 in 1995, considerably below the reproduction rate necessary for a stable population. In Singapore, there is a significant drop in total fertility rate from 6.4 to 2.62 between 1950 and 1970, and there is a further reduction to 1.69 in 1980s. Besides, their life expectancy at birth have been largely extended by 17.2 percent from 1950 to 1975 and it is projected to extend over 80 years in 2015. This double ageing explains the rapid rate of ageing

Singapore.

Figure 3: Old-aged Dependency Ratios of Selected Countries
Estimates 1950-1995 and Medium Variant 1995-2050

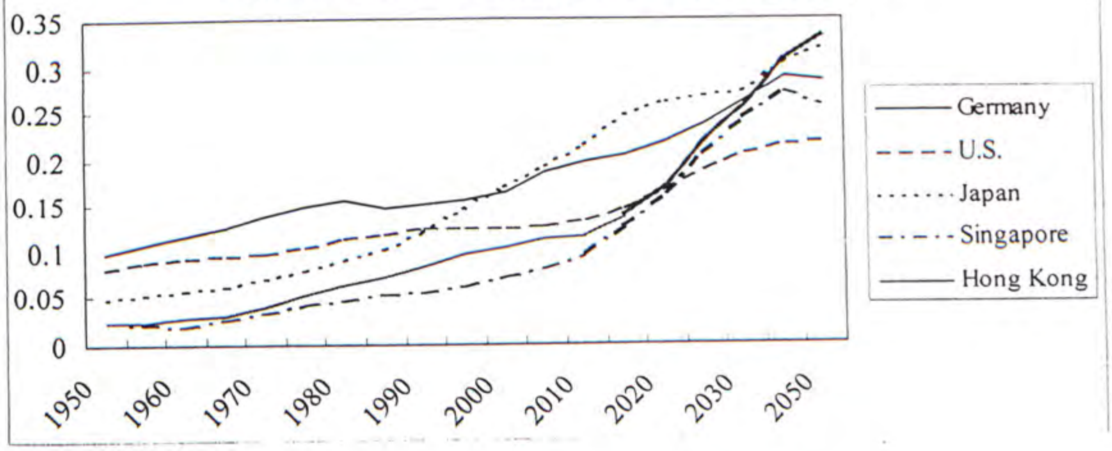


Figure 4: Total Fertility Rate of Selected Countries
Estimates 1950-1995 and Medium Variant 1995-2040

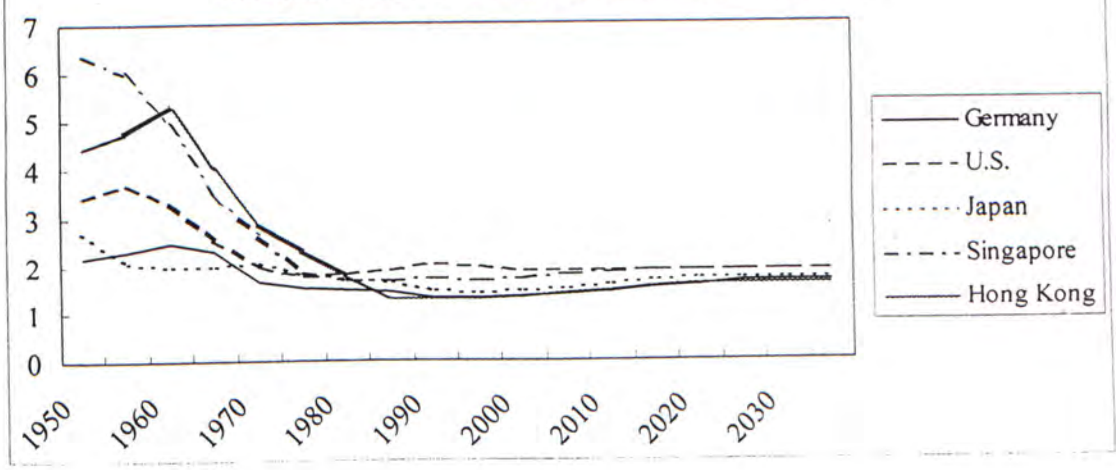
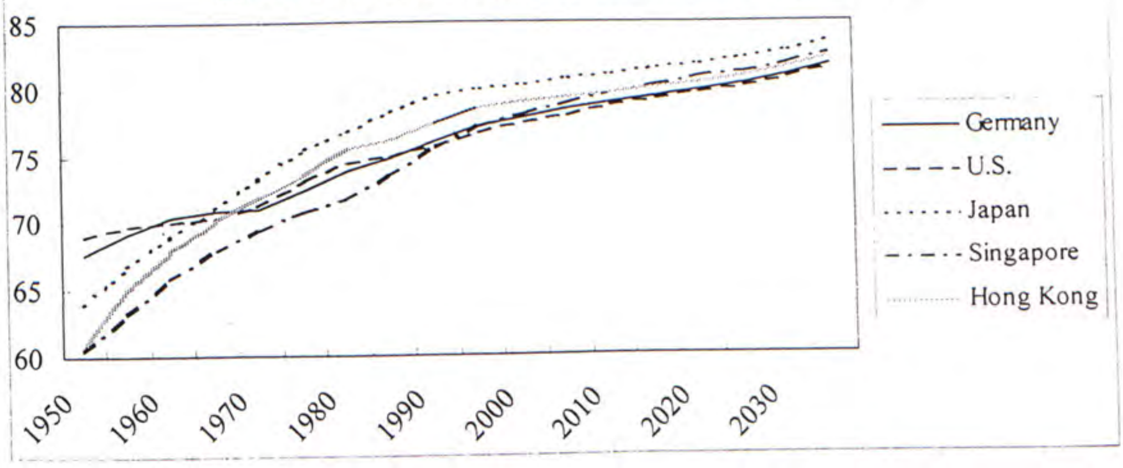


Figure 5: Total Life Expectancy of Selected Countries
Estimates 1950-1995 and Medium Variant 1995-2040



C. Demographic Changes of Hong Kong

As a matter of interest, the detailed figures about Hong Kong's total fertility rate per woman and the life expectancy at birth are given in Table 2.1. It is found that the total fertility rate was highest during early 1960s. Actually, the fertility rate maintained at a pretty high level, more than 4, throughout the periods of 1950 to 1970. It can be explained with some historical factors. During the two decades after World War II, the society required more manpower to re-build the economy and hence post-war baby boom happened. Besides, during the period of 1960s, there was large number of immigrants from Mainland China, who contributed the large portion of Hong Kong population.

In the early of 1980s, the total fertility rate dropped to 1.8, which is threefold less than that in 1960s. It might be the results of the government promotion of birth control program and undergoing the economic takeoff. At that time, the Hong Kong Government greatly promoted the family planning and birth control. We had a slogan, "Two is enough!" which was used to encourage people to have a small family with two children only. Moreover, Hong Kong experienced its economic takeoff during 1980s. As shown in Barro and Sala-i-Martin (1995), they estimate the relationship between fertility and per capita GDP and they find that the relation is positive at very low levels of per capita GDP and negative at higher levels. When the effect of child-rearing costs that depend positively on wage rates or per capita stocks of human capital becomes dominant, this negative relation is predicted – which holds for all but the poorest countries. Compared with the average total fertility rate for Asian regions, the values for Hong Kong are lower than the average over time.

Hong Kong's life expectancies at birth for both sexes increase monotonically over time. On average, before 1970s, females can expect to live 7.3 years more than males. After 1980s and projected to 2050, males can expect to live 5.5 years less than females. Combining both sexes, the life expectancy at birth was increased by 10 years from 1950 to 1965. According to United Nations (1999)'s medium-variant projections, it is expected that people can live 10 years more (i.e.79.1 years in 2015) over 5 decades from 1970. People can expect to live over 80 years after 2015. Compared with the figures for Asia, Hong Kong people have longer life expectancy than that in other Asian regions over time.

Only looking at the demographic factors is not clear enough to see the picture of ageing. The matter is to what extent that the factors achieved to alter the compositions of the population that influences the economic growth. For example, it is possible that both declining in fertility and mortality would not alter the percentage of working population, say aged between 15 to 64, who are the main pillars of the society, if either of these declining rates is small enough or immigrants of working aged are allowed. In short, it is very meaningful to examine the age distribution of the population as well.

Table 2.2 presents the figures of Hong Kong population and age distribution. Considering the column of percentage change of total population, there were more than 20 percent population increased during the period of 1950s to 1960s. At the same time, the population aged between 1 and 4 had about 16 percent and it was the peak time of fertility. This implies that there is a large portion of increased population come from new-born baby. However, the percentage aged 0-4 is decreasing since 1970s and the percentage aged 65 or over is increasing over time. The former group is projected to fall to 3.9% in 2040 from 8.2% in 1980. On the contrary, the latter group is projected to rise from 6.5% in 1980 to 21.5% in 2025 and further to 30.3% in 2040. It seems that the influence of mortality decline is greater than the influence of fertility decline in Hong Kong's ageing from 1980 to 2040.

Let us turn to focus on the trend of population aged between 15 and 64, which are often named as working population. They are supposed to contribute the most to the society and they are the sources of financing the social security for old age. If this group becomes smaller and the old-aged group (or the dependency group) becomes bigger, it is obvious to know that the burden of the working group will be increased. In Hong Kong, the working population increases from 59% in 1970 to 74% in 2010. The anxiety about ageing population does not bother Hong Kong in the short term. However, it does a matter to Hong Kong in the long run because the working population is projected to decline to 54.4% in 2050; at the same time, they need to support over 30% of aged population. Therefore, we should pay more attention on the ageing matter.

D. Fertility-dominated or Mortality-dominated ageing?

Generally, fertility decline has played a greater role than mortality decline in population ageing. Ogawa (1986) estimated that the influence of fertility decline was 4.2 times greater than the influence of mortality decline in Japan's ageing from 1950 to 1980. Nevertheless, the figures are telling us that the role of the influences will be reversed. The shift from fertility-dominated to mortality-dominated ageing will happen. It is because, as indicated in Figure 4, the rate of declining in fertility usually slows down after reaching the replacement level. At the same time, the mortality decline has continued without significant stagnation in many countries such as the five selected countries. In an extreme case, the total fertility rate in Japan declined from 2 to 1.7 between 1960 and 1987, but the life expectancy at birth kept rising from 70.2 to 81.4 for females and from 65.3 to 75.6 for males throughout the same period of time. Moreover, the ageing of population itself reinforces effects of mortality decline on population ageing. Generally, the population ageing is initially fertility-dominated partly because the fraction of children is considerably greater than the fraction of the elderly. However, as the proportion of old person increases, the numerical impact of a change of its proportion on the entire age distribution tends to become more significant.

In sum, the total fertility rate has a downward trend and will keep an almost constant fertility rate when the country reaches or even falls below the replacement zone, while life expectancy at birth has a significant upward trend over the same time. Meanwhile, the percentage of young-aged group is decreasing and that of old-aged group is increasing. Furthermore, the effect of declining in mortality will dominate the effect of declining in fertility in population ageing.

CHAPTER 3

LITERATURE REVIEW

Before going through the relevant literature review, let me first indicate what measurements are commonly used for measuring ageing and explain what are the differences between savings and investment in the sense of expenditure approach. Afterwards, previous studies related to the impacts of ageing on savings and economic growth will be reviewed.

A. The Measurements of Ageing

In general, there are three measurements widely used for measuring population ageing. The first one is the life expectancy at birth in years and the second one is the old-age dependency ratio, which is the ratio of the population aged 65 or over to the population aged between 15 to 64. The last one is the probability of survival in old age. Obviously, larger values of these measurements mean older population of the economy.

Apart from these, Cutler et al. (1990) construct a measure of consumption "needs" that varies by age, adjusting for the different levels of education spending, medical spending, and other consumption of children, the elderly, and working-age adults. Their summary measure weights people aged under 20 at 0.72 the consumption need of a working-age adult and people over 65 at 1.27 times the consumption need of a working age adult. Using these weights, one can construct a needs-adjusted dependency ratio.

There are some other ageing measurements used in previous literature and the main variation of the measurements is the selection of the range of the age group.

For example, Schmidt-Hebbel et al. (1992) perform a cross-sectional estimation on household savings for 10 developing countries. They combine youth and elderly ratios as a single dependency variable and the dependency ratio is defined as a percentage of the total population rather than the traditional one, percentage of the working population, say aged 15-64.

Why do population get ageing? Other than the historical factor and the biological or technological factor, the factor of systematic variations in individual's demand for longevity should also be considered. Ehrlich and Chuma (1990) develop and apply a model of the demand for longevity under conditions of certainty. They specify a demand function for longevity, or "quantity of life," along with corresponding demand functions for indicators of "quality of life" and a value-of-health and life extension function. They predict theoretically that optimal health and longevity are increasing functions of endowed wealth rather than current income. The longevity model implies individuals who survive to an increasingly older age have a correspondingly higher initial health endowment. Empirical evidence reveals a lower mortality rate for females relative to males at all age groups beginning at birth, presumably indicating a higher level of endowed health for females.

B. Relationship between Savings and Investment

Looking from the expenditure approach, we will have the following equations:

$$Z = C + I + G + (X-R)$$

$$Z = Y + T$$

$$Y + T - C - G = S = I + (X-R)$$

i.e. Total savings = Total investment

, where Z = real GDP,

C = real consumption,

I = real domestic investment,

G = real government purchases,

X = real exports, R = real imports,

Y = real disposable income,

T = real tax,

S = real domestic savings.

Savings contributes to economic growth by freeing up resources that can be employed to raise the productive capacity of the economy by increasing the amount of capital – equipment, machinery, buildings, and so on. In general, additional investment contributes to higher output per worker.

For the world as a whole, savings and investment are identical so that factors that influence the total savings of all nations combined inevitably influence total investment. But for any particular country, investment may differ considerably from savings to the extent that countries rely on direct foreign investment, loans from foreign financial institutions and individuals, and loans and grants from such multilateral and bilateral development agencies as the World Bank and the US agency for International Development.

Domestic savings is by far the most important source of investment funds. Mason (1988) shows that there is a close association between domestic savings and investment for most countries. The simple correlation between the savings and investment rates is 0.74 and each percentage point increase in savings is estimated to increase the investment ratio by six-tenths of a percentage point. In more extensive studies, Feldstein (1983) and Feldstein and Horioka (1980) argue that the domestic supply of savings is an important determinant of investment owing to substantial impediments to capital mobility across international borders. Their empirical analysis confirms the very close correlation between savings and investment and they conclude that domestic savings is the major determinant of investment.

Because of the close relationship between savings and investment, and due to the availability of data, recent research like Zhang & Zhang (1999) uses the average ratio of gross real domestic investment to real income from 1970 to 1985 as proxies for savings rate. It is believed that the performance of investment rate in regression analysis can reflect the relative performance of savings rate in a great extent.

C. Relationship between Ageing and Savings

The life-cycle model focuses on the ability of individuals to transfer resources from their working years to their old age via savings. The key effect of ageing in a life-cycle framework is to lower the savings rate, by increasing the fraction of the population that is dissaving and decreasing the fraction that is savings. In other words, life-cycle hypothesis (LCH) predicts that wealth should decline with age.

There are two ways to examine the impact of demographic change on national savings. One way is to examine micro data on the savings of individuals and then to aggregate to get national savings. The second way is to examine macro data – that is, to exploit the time-series and cross-country variation in demographic structure to examine how ageing influences national savings.

Weil (1994) compares these two approaches and shows that they lead to strikingly different conclusions. Micro data show little dissaving by the elderly. Yet macro data show that nations with a large elderly population tend to have low savings rates. He reconciles these two results by emphasizing the role of bequests.

The failure of the elderly to dissave implies, as a matter of logic, that the elderly are dying with substantial wealth and thus leaving substantial bequests. Actually, there are substantial evidence (e.g. from Kotlikoff and Summers, 1981) that bequests are an important component of wealth accumulation. Even if these bequests are accidental rather than the result of a bequest motive, they cannot be ignored, because somebody is receiving them. These recipients will presumably consume more in response. Thus, nations with a large elderly population save less not necessarily because the elderly dissave, but perhaps because the young consume more in response to the greater likelihood of receiving a bequest.

Tobin (1967) analyzes two simulation models: both describe steady-state economies in which consumption and earning, and hence savings, vary by age. One includes only the rate of growth effect which implies that rapid population growth encourages savings. With age profiles dominated by the pension motive, young households save and older households dissave. A high population growth rate generates an age distribution tilted toward young, savings households and, consequently, aggregate savings are higher. The second model incorporates the dependency effect, which implies that rapid population growth discourages savings, by introducing more realistic consumption and earning profiles based on survey data for the United States. Nevertheless, Tobin provides estimates for only on rate of population growth so that he fails to show whether the relationship between savings and population growth is dominated by the rate of growth effect or the dependency effect.

Masson and Tryon (1990) simulate the effect of population ageing by assuming that population ageing will reduce savings rates, reduce labor supply and increase government expenditure. Their results show that population ageing will increase real interest rates, decrease capital stock and decrease real output. It should be noted that their model basically belongs to Keynesian-type in the sense that increases in government expenditures lead to large aggregate demand, which is not an appropriate property for a long-term projection model.

Mason (1988) shows that countries with low dependency ratios have higher aggregate savings rates from the analysis of international cross-section data from the 1960s and time series data from Asian countries.

Horioka (1991, 1992) makes a single-equation analysis of Japan's savings rate in conjunction with the age structure of the population and uses the estimated regression coefficients to project its future trends. Explanatory variables are the old-age dependency ratio and the young-age dependency ratio, which are the ratios of the population aged 65 years and over and the population aged 19 years and under to the population aged 20-64 years, respectively. A major conclusion of Horioka's projection is that Japan's private savings ratio (both household and corporate sector) will become negative after the year 2007 with rapid population ageing.

Besides, results obtained from panel data as illustrated in Hurd (1990) show that elderly gradually use up their wealth and this result tends to support the LCH. His empirical analysis is based on the data from Retirement History Survey, which is a ten-year longitudinal survey of 11,153 U.S. households whose heads were 58-63 in 1969. The heads are questioned about income, assets, employment, health, and social and family interactions in every two years. Information about the choices made by the households and about associated variables as the cohort moved through its retirement years would be included in the data set. Furthermore, estimated from the macro panel data, Heller and Symansky (1997) show that both the elderly dependency rate and the youth dependency rate are negatively (significantly) related to the private savings and national savings for the Asian Tigers from 1990 through 1996[2].

However, there are numerous empirical studies which point out that one of the empirical problems with the life-cycle model is the "failure" of the old to dissave to the extent predicted in the model. As shown in Mirer (1979) and Menchik and David (1983), cross-section data on wealth holdings by age sometimes show that wealth increases with age, implying that the elderly save as they age rather than dissave as required by LCH.

Ehrlich and Lui (1991) show that a longevity shock will exert systematic effects on the economy's savings rate. Following a significant exogenous increase in the probability of survival in old age alone, the savings rate raises immediately and continuously until it reaches its long-run constant value. Barro and Sala-i-Martin (1995) perform the regression for the investment ratio on the life expectancy using cross-sectional data. They find that there is positive relation among these two variables.

From the aspect of labor market, Yashiro and Oishi (1997) argue that treating the labor supply and technological change factors as endogenous rather than exogenous will alter the projections of savings and investment trends. As the labor supply becomes scarce with a declining fertility rate, more rapid technological change may be induced, partly offsetting the negative impact of population ageing on savings and investment.

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[2] The data they used is taken from the World Economic Outlook data files of the International Monetary Fund.

D. Relationship between Ageing and Growth

Ehrlich and Lui (1991) develop an overlapping-generations model of endogenous growth. They show that optimal intergenerational trade can lead to maximization of growth opportunities while population ageing may raise the growth rate, an increase in young-age longevity is likely to produce a greater increase in the growth rate. To analyze the effects of ageing, they introduce the probability of survival from age 50 to 75 as an explanatory variable. Meltzer (1992), using a more detailed age group classification in which probability of survival are weighted by the number of years within each age class, finds that the results are similar to those in Ehrlich and Lui.

Analyzed from cross-sectional data, Barro and Sala-i-Martin (1995) show that life expectancy at birth, which is taking in log form and used as its own instrument, is highly positively significant in the growth regressions for 1965-75 and 1975-85. People have higher life expectancy, which is a good indicator of having good health and it reflects the existence of some other desirable features of the economy. For instance, higher life expectancy may go along with better work habits and a higher level of skills (for given measured values of per capita product and years of schooling). Similar results can be obtained from Collins and Bosworth (1996) but the dependent variable is growth of output per worker instead of growth of per capita income.

Note that the growth of per capita income will be used in this empirical study rather than using the growth of per worker. This is because the definition of a worker or a potential worker is arbitrary and the results are sensitive to the specific choice of the age at which one starts to work and the retirement age. Moreover, one of the assumptions made in those kind of model is that the productivity of worker over the work period is flat. Another assumption is that the net contribution to production by young children or elderly persons is zero. These assumptions are unrealistic and there is no a priori reason to believe that the net contribution of the young or elderly group is zero rather than positive or negative.

Sarel (1995) examines the effects of demographic dynamics on the measured rates of economic growth by developing a production model with labor productivity that varies with age. Macro data, which is in the form of two international panel databases – a macroeconomic database (Penn World Table-5.5 is published by Summers and Heston (1991)) and a demographic database (United Nations, 1990), is used. He estimates the labor productivity during 1950-1985 and finds that the estimated productivity coefficients support the expected "inverse-U" shape. Children at age 7 and below have a negative net productivity. The net productivity becomes positive and goes upward since age 8. The productivity is at the peak, 2.48, when the age reaches 55. The decline in productivity at old age is shown as insignificant.

There is a causality problem that the direction of the effects between ageing and economic growth. That is, does population ageing affect growth or does economic growth cause ageing? Ehrlich and Chuma (1990) puzzle that longevity may be partly an endogenous variable that is affected by the growth rate of per capita income. However, for simplicity, ageing variables are assumed to be exogenous in this thesis.

E. Relationship between Savings and Growth

The causality question is raised again for the relationship between savings and growth. As we all know, savings and growth have been highly correlated over long time horizons as well as for many regions and stages of development. On one hand, growth and higher incomes helps capital accumulation by raising more households above the subsistence level, below which they cannot save. Deaton (1989) shows graphically that there is a positive relationship between gross savings ratio in 1986 and the growth rate of GDP during 1980-1986 in 106 countries, with the savings rate increasing 1-1.5 percentage points for every percentage increase in growth, but statistical insignificant.

Besides, Lahiri (1989) studies savings in eight Asian countries, which also mentions the dependency issue. He uses a general framework that distinguishes private and public savings and incorporates the effects of growth, dependency, inflation, terms of trade changes, and the importance of exports in GNP. The framework is based on the behavior of household – infinitely lived household. He shows that growth unambiguously leads to increase private savings in all countries with a long-run elasticity of about one. On average, a one-point increase in the percentage of population in the age group 15-64 leads to a 1.6 percentage point rise in average propensity to save in the long run except in Indonesia and the Philippines, where no lasting effect of the age composition on savings is found.

On the other hand, growth in capital is also the major factor that attributes to the economic growth of a nation. Since output is directly affected by investment and the source of investment mainly comes from savings, output level is closely associated with savings. Higher savings and investment will enhance the economic growth with higher level of output. The following studies have shown empirically for the importance of savings to growth.

In growth models with endogenous fertility, such as Barro and Becker (1989) and Becker, Murphy and Tamura (1990), per capita growth and net fertility tend to move inversely. The effect on fertility involves an increase in the value of parents' time and thereby a rise in the cost of raising children. More generally, any change that increases the cost of raising children tends to reduce fertility and to increase desired savings per person. In effect, people shift from savings in the form of children to savings in the form of physical and human capital. The increase in desired savings raises the per capita growth rate in models of endogenous growth.

One of the important lessons learnt from Barro (1991) is that investment rate (or savings rate) is strongly positively related to growth. If bequests are non-operative, agent save less when they receive more pension benefits in old age as argued in Zhang (1995). As a result, per capita growth is lower. The theoretical model in Zhang and Zhang (1999), equation (16) indicates that the growth rate depends positively on the fractions of time and income invested in child education and the savings rate, but negatively on fertility.

As a whole, both theoretical model and empirical evidences indicate that there is a positive link between growth and savings. The matter of the robustness of the empirical results have been shown by Levin and Renelt (1992) who identify a positive, robust correlation between growth and the share of investment in GDP. They use a variant of Edward E. Leamer's (1983) extreme-bounds analysis (EBA) to test the robustness of coefficient estimates to alterations in the conditioning set of information.

F. Summary

In the issues of demographic change, there are different kinds of ageing measurements in which life expectancy at birth, dependency ratios and the probability of survival in old age are widely used. Selection of the measurements depends on the specific interest of the authors and the availability of data. The range of the aged group selected is the major variations in defining the dependency ratios for the previous literature.

Owing to the availability of data, the dependency ratios will be defined as the percentage of the female (male) population of aged 65 or above to the total female (male) population in this thesis. In the previous literature, they have not mentioned the sex differential in the influence on savings and growth. Since, in general, female has a lower mortality rate and longer life expectancy than male, the fraction of female population aged 65 should be larger. Level of education attainments and the nature of work are also different by gender and hence the output level (productivity) should be different as well. Do female and male exert different impacts on savings and growth? If they do, who would exert greater magnitude? Another traditional measurement, life expectancy at birth, will also be used in this thesis and its impacts on savings and growth will be examined through not only looking at the total life expectancy, but also the sex differential in life expectancy.

Both theoretical and empirical studies, such as Feldstein and Horioka (1980) and Mason (1988), show that savings and investment are closely linked together. When there are lack of data for domestic savings rate, the investment ratio seems to be a good proxy for the savings rate.

Numerous studies have examined the relationship between ageing and savings. Panel data, cross-sectional data and time-series data in terms of micro and macro data have been employed in the previous studies. Some of the authors, namely Tobin (1967), also construct simulation models to describe the effect of population growth over savings. Comparing the literature, the estimation results from using panel micro and macro data and time-series of specific regions tend to give a negative link between population ageing and the savings (e.g. Hurd, 1990; Heller and

Symansky, 1997). It supports the life-cycle hypothesis that wealth should decline with age. While most of the cross-sectional macro data are employed, the estimation results tend to give a positive relation between savings and age (e.g. Barro and Sala-i-Martin, 1995).

One thing worth noting is that the ambiguous previous empirical findings for the impacts of ageing on savings can be classified into two groups and they have their common features indeed. The first group is those who use dependency ratio as the measurement of ageing, namely Mason (1988), Horioka (1991, 1992) and Heller and Symansky (1997), and the second group is those who use life expectancy at birth instead, namely Ehrlich and Lui (1991) and Barro and Sala-i-Martin (1995). The former group commonly gives the negative relationship between savings and ageing while the latter group consistently gives the positive relation. When we look carefully about the interpretation of these two measurements for population ageing, we will know why they got different sign. This part will be discussed thoroughly in Chapter 5 (section D).

The influence of ageing on savings is clear from the theoretical conclusion, but the empirical estimates have been mixed. Therefore, I would like to find out the relationship between these two variables by using different sets of international macro data: panel and cross-sectional data. Are the estimation results consistent with the previous studies? Which sets of data would give a better measurement on the impacts of ageing? What are the pros and cons of using panel and cross-sectional data in the issue of ageing? All these questions will be answered or discussed in this thesis.

Empirically, most of the previous literatures show that ageing is positively associated with the economic growth. Barro and Sala-i-Martin (1995) suggest that the economy with population ageing should possess some good attributes that would enhance the economic growth. To have a concrete explanation for the positive relationship between ageing and growth, we should focus on how ageing affects some variables and how these variables in turn affect growth. Back to the theme of this research, we will investigate how ageing affects savings and then how savings affects economic growth.

CHAPTER 4

EMPIRICAL SPECIFICATIONS AND DATA

In this empirical study, there are two major data sets. One is panel data set, which comes from World Bank Data 1995 and the another one is cross-sectional data set, which comes from Barro (1989)[3]. In order to examine the impacts of population ageing on the savings rate and the economics growth, the following two general equations will be used:

Savings $=\alpha_0 + \alpha_1$ real per capita GDP $+ \alpha_2$ gross enrollment ratio for primary level $+ \alpha_3$ gross enrollment ratio for secondary level $+ \alpha_4$ government consumption $+ \alpha_5$ growth rate of terms of trade $+ \alpha_6$ population aged above 65 or life expectancy at birth $+ \alpha_7$ revolutions and coups $+ \alpha_8$ assassinations

Growth $= \beta_0 + \beta_1$ real per capita GDP $+ \beta_2$ gross enrollment ratio for primary level $+ \beta_3$ gross enrollment ratio for secondary level $+ \beta_4$ government consumption $+ \beta_5$ savings rates $+ \beta_6$ growth rate of terms of trade $+ \beta_7$ population aged above 65 or life expectancy at birth $+ \beta_8$ revolutions and coups $+ \beta_9$ assassinations

The direction of causality is one of the necessary assumptions in this study. It is assumed that income responds immediately to changes in the age distribution, but that the age distribution is "sticky" in the short run and cannot respond immediately to differences in growth rates. Over longer periods, the demographic distribution may respond to differences in growth rates through changes in fertility and in life

[3] I am grateful to Holger Wolf and Prof. Zhang for providing the Barro-Wolf data set and World Bank data set. Most variables are in the form of averages from 1970 to 1985. See Sala-i-Martin (1994) for a brief survey of the recent empirical growth literature based on cross sectional analyses.

expectancy.

A. Expectations of variables in savings equation and in growth equation

In the neoclassical growth models of Solow-Swan and Ramsey, the change of steady-state position reflects the influences of the control and environmental variables on the growth rate. For instance, steady-state level of output per effective worker would be raised if the value of investment ratio or savings rate is exogenously increased and hence the growth rate tends to increase accordingly but it is not for the long-term per capita growth rate. The basic assumption of the model is that investment ratio does not change as an economy develops. However, observing from the empirical findings, the growth effect of a variable such as the investment ratio lasts for a long time if the adjustment to the new steady-state position takes a long time[4]. As mentioned before, empirical studies show that there is a robust positive relation between savings and economic growth and similar result would be expected here.

The variable LPCGDP is the log of per capita GDP from 1975 to 1980 in the pooling estimations and the variable GDP70 is per capita GDP for 1970 in the OLS estimation. Conditional convergence[5] predicts that higher growth in response to lower starting per capita GDP with holding other explanatory variables constant. Barro (1991) also shows that a poor country tends to grow faster than a rich country, but only for a given quantity of human capital. Dayal-Gulati and Thimann (1997)

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[4] As argued in Barro and Sala-i-Martin (1995), education attainment and life expectancy rise systematically with the level of development, and these changes would be associated with increases in investment ratio.

[5] The negative relation between the growth rate and the initial level of income is called the convergence hypothesis. This concept was labeled β-convergence by Barro and Sala-i-Martin (1992) to distinguish it from σ-convergence, which was defined as the reduction of cross-sectional dispersion over time. The growth rate of an economy is predicted to be inversely related to the distance from its steady state which is known as "conditional convergence".

analyze empirical determinants of private savings for a sample of Southeast Asian and Latin American economies over the period 1975-95. The economic data were taken from the IMF's WEO database, and the data on demographics were taken from United Nations (1994). Panel regressions are used to establish empirical relationships between determinants of savings and the rate of private savings. It is found that increases in per capita income have an insignificant positive impact on savings.

Gross enrollment ratios at primary level (PRIMARY and PRI70) and at secondary level (SEC and SEC70) are used as proxies for human capital investments as in Barro and Sala-i-Martin (1995) and O'Neill (1995). As human capital is an important asset of the economy, the level of the human capital investment can reflect the prosperity of the society in some sense. If the society invests more in human capital (e.g. schooling and on-the-job training), better research and development (R&D) can be acquired and the efficiency of the worker can be enhanced. Besides, the progress of technology development can be improved via upgrading the human resources. It is well known that the long-run or steady-state growth rate is given by the rate of exogenous technological progress. Besides, in endogenous economic growth model, with technological progress, countries with greater initial stocks of human capital experience a more rapid rate of introduction of new goods and thereby tend to grow faster (Romer, 1990).

The effect of population ageing, which can be reflected by old age dependency ratio as well as life expectancy at birth, on domestic savings is uncertain. On one hand, the savings will decline as the portion of aged population is getting larger given in the absence of bequest motive for savings. This is one of the major implications of the life-cycle hypothesis. Individual will dissave when they get old, such as after retirement. Thus, it is expected that the fraction of aged population will exert negative impact on savings. On the other hand, the life expectancy at birth is expected to give a positive impact on savings according to our conventional wisdom. Since variables used for measuring ageing, old-aged dependency ratio and life expectancy at birth, are estimated separately in the previous empirical studies. It is worth entering them into the model so as to see whether their sign still hold even when controlling one to another one.

Again, population ageing would exert two offsetting impacts on the economic growth. On one hand, ageing would retard the growth of the economy through distributing more society resources to support the large pool of elderly group. During the retiring life, the productivity of the elderly will decline and consumption will be their main activity. When the portion of the elderly increases, more resources is distributed to support them. At the same time, if the portion of the working population is getting smaller, the matter of ageing will be the burden of the society. On the other hand, longer life expectancy indicates people have better health circumstances that improve the working efficiency as well as productivity. Other than health, the society must possess some other desirable features that can be revealed from longer life expectancy. The gain from these desirable features may offset or over the loss from supporting the elderly; that turns out there still have a positive growth rate.

Government consumption and political instability are believed to be harmful for savings and growth. Government expenditure has adversely effect to savings especially when it is financed by income tax. Besides, the steady-state level of output per worker would decrease with the rise of government consumption and hence it would lower the growth rate for given values of the state variables. Political instability is always looked as equivalent to a decline in the security of property rights and thereby it creates risks for the returns to savings. Greater instability lowers the incentive to invest in various activities and lower the steady state level of output per effective worker and hence lower growth rate.

Growth rate of the terms of trade over the period of 1975-85 (GRTRADE) is exogenous to the behavior of an individual country. It is because the terms of trade is defined as the ratio of country's index of average export price to the average import price index, which is determined on world markets. Improvement in terms of trade raises a country's real income and the consumption will then be increased. However, its effect on individual economy is ambiguous. It depends on a response of allocation or effort to the shift in relative prices. For example, if the price of the export goods is increased, the exporting country tends to produce more output. So, the effects of terms of trade is positive to growth. Nevertheless, in general framework, Lahiri (1989) distinguishes private and public savings and incorporates the effects of terms of trade changes on savings in eight Asian countries, and he finds that on average adverse terms of trade changes tend to depress private savings. Dayal-Gulati and Thimann (1997) gives similar result that positive terms of trade shocks increase savings through the positive effect on wealth and income.

One of the channel to reflect the quality of education is to measure the student-teacher ratio in primary level and secondary level (STUTEPRI and STUTESEC respectively). Higher value of these ratios imply lower quality of education and output per effective worker and thereby there is a negative link with growth. For these two variables, data from World Bank are combined with Barro and Lee[6] (1997)'s data set so that the number of missing observations will be reduced and the accuracy of the results can be increased. The observations from 1975 to 1980 are drawn for panel analysis and the observations in 1965 and 1970 are drawn for cross-section analysis. STUTEPRI and STUTESEC are only used in non-poor countries samples. Reasons of doing so will be explained more in later part.

Adding dummy variables for the region of sub-Saharan Africa and Latin America[7] in the full samples of both panel data analysis and cross-sectional data analysis, it can reveal the included regressors whether they can explain well the low in savings rates and in economic growth in these regions. (For the countries included in the regressions, the average savings rate and the average per capita growth rate in sub-Saharan Africa are 0.15804 and 0.002988 below the means in 1975-80 and; 0.15258 and 0.00432 below the means in 1970-85. The corresponding values for Latin America are 0.2292 and 0.018084 and; 0.18015 and 0.00461.)

[6] Using Barro & Lee (1997)'s data set, it provides more detailed information about the quality of schooling in cross-section of countries.

[7] The regions selected are according to the classifications from World Bank's world-table.

B. Specifications for panel data analysis

(i) The Data

The data used in this section come from World Bank Data 1995. This database contains 222 countries and 730 series with actual data range from 1960 to 1993. This type of data is called panel data which possess the properties of cross-sectional data and time-series data. However, in this database, not all series have continuous data from the above period for every country. Particularly, in the early period, say before 1970, there are no data given from most countries. Data for poor countries are also very insufficient. Besides, for some variables such as life expectancy at birth, data are mostly provided in every five years rather than every year. The matter of data availability imposes some difficulties on performing pooling regression as it requires all estimated countries should have same number of observations throughout the whole estimated period for all interested variables. In order to satisfy this condition, this becomes the criterion of selecting countries and estimation period. Eventually, there are 77 countries with continuous yearly data from 1975 to 1980 selected as a full sample (except the variables for measuring ageing, detail specification will be mentioned in the later part). The interested variables are measured in U. S. dollars and they are in real terms with 1987 as the base year.

(ii) Methodology

In order to perform panel data analysis, pooling regression will be used to combine cross-section and time-series data. The approach of assuming a random intercept to give an error components (or variance components) model that can be estimated by generalized least squares will be performed. The pooling estimations are based on the assumptions employed by Kmenta (1986) that disturbance covariance matrix gives a cross-sectionally heteroskedastic and timewise autoregressive model.

Suppose there are N cross-sectional units observed over T time periods to give a total of N x T observations.

$$Y_{it} = X'_{it}\beta + \varepsilon_{it} \qquad \text{for } i = 1,\ldots,N \quad t = 1,\ldots,T$$

where β is a K x 1 vector of unknown parameters and ε_{it} is a random error.

The assumptions of the Kmenta model are as following:

$E(\varepsilon_{it}^2) = \sigma_i^2$	heteroskedasticity
$E(\varepsilon_{it}\,\varepsilon_{jt}) = 0$	for i $\neq$ j, cross-section independence
$\varepsilon_{it} = \rho_i\,\varepsilon_{i,\,t-1} + v_{it}$	autoregression

and $E(v_{it}) = 0$, $E(v_{it}^2) = \phi_{ii}$, $E(v_{it}\,v_{jt}) = 0$ for $i \neq j$, $E(v_{it}\,v_{js}) = 0$ for $t \neq s$, and $E(\varepsilon_{i,\,t-1}\,v_{jt}) = 0$.

An estimate for β is obtained by a generalized least squares (GLS) procedure. The steps of the procedure are shown below.

Step 1: Estimate β by OLS and obtain estimated residuals e_{it}.

Step 2: Use the estimated residuals to compute $\hat{\rho}_i$ as estimates of the ρ_i.

$$\hat{\rho}_i = \sum_{t=2}^{T} e_{it}e_{i,t-1} \Big/ \sum_{t=2}^{T} e_{i,t-1}^2 \qquad \text{for } i = 1,\cdots,N$$

Step 3: Use the $\hat{\rho}_i$'s to transform the observations, including the first observation (see Kmenta[1986, Equation 12.27, p.619]) and apply OLS to the transformed model. The error variances and covariances ϕ_{ij} are estimated from the regression residuals of the transformed model.

Step 4: Obtain the GLS estimator. With final parameter estimates $\tilde{\beta}$ and $\hat{\rho}$ the transformed residuals are:

$$\widetilde{v}_{it} = \widetilde{e}_{it} - \hat{\rho}_i \widetilde{e}_{i,t-1} \qquad t = 2,\ldots,T$$

$$\widetilde{v}_{i1} = \sqrt{1-\hat{\rho}_i^2}\,\widetilde{e}_{i1}$$

where $\widetilde{e}_{it} = Y_{it} - X'_{it}\widetilde{\beta}$

The variance of the residuals is computed as:

$$\hat{\sigma}^2 = \frac{1}{NT-K}\sum_{i=1}^{N}\sum_{t=1}^{T}\widetilde{v}_{it}^2$$

Since the restrictions of equality across cross-sections are imposed on the estimation of parameter, Buse R^2 measurement of goodness of fit is not bounded by zero. The Buse Raw-moment R^2 is obtained by replacing *Y-DY* with *Y*.

Here, $$\text{Buse } R^2 = 1 - \frac{\widetilde{e}'\hat{\Omega}^{-1}\widetilde{e}}{(Y-DY)'\hat{\Omega}^{-1}(Y-DY)},$$

where *Y* is an *NTx1* vector of observations stacked by cross-section unit and

$$\hat{\Omega} = R(\hat{\Phi} \otimes I_T)R',$$

where *R* is the *NTxNT* matrix that performs the autoregressive transformation and is given in Guilkey and Schmidt (1973). The matrix *D* is constructed as:

$$D = W(W'\hat{\Omega}^{-1}W)^{-1}W'\hat{\Omega}^{-1},$$

where *W* is a *NTxN* matrix such that column *i* has a vector of 1's for cross-section *i* and 0's elsewhere. Therefore, the expression *Y-DY* transforms the observations to deviations from a weighted mean.

(iii) Specifications

There are totally five variables used as proxies of ageing. They are the percentage of female population age 65 or above (female aged population hereafter, FEMALE), the percentage of male population age 65 or above (male aged population hereafter, MALE), total life expectancy at birth (LTOT), female life expectancy at birth (LFEM) and male life expectancy at birth (LMAL)[8]. The observations of variables FEMALE and MALE are drawn from 1965 to 1970 and the observations of variables LTOT, LFEM and LMAL are drawn from 1967 to 1972.

In the previous literature, savings rate is used to be proxied by investment rate as in Barro (1989) which might due to the availability of data. Since both the data of the real gross domestic savings rate and the real gross investment rate are provided in the World Bank data set, it is interesting to see any differences of using these two indicators for proxy savings rate in the savings equation.

In the growth equation, the dependent variable is the growth rate of real per capita GDP from 1975 to 1980. That is, growth rate is measured from time t to time $t+1$. To see the different impacts of savings on the economic growth, variables SAVGDP and INVGDP will be in turn to be placed in the equation. The preceding six periods (1967-74) values of government consumption are used instead of 1975-80. This can help to understand more about the influences of government spending to the future economic growth.

Owing to the limited data, the impacts of the number of revolutions and coups per year and the number of assassinations per million population per year from 1975-80 on both savings and growth will not be estimated in the panel data analysis.

C. Specifications for cross-sectional data analysis

Performing cross-sectional data analysis, Ordinary Least Square estimation method will be employed. Countries selection criteria is similar to Barro's (1991) and those countries having few observations for some important variables such as life

[8] The detailed definitions of each variable are provided in Appendix 3.

expectancy are excluded. And hence there are totally 91 countries selected as a completed sample. Most of the variables are measured in their average value over the 1970 to 1985 period. Because of lacking of ageing variables in Barro data set, the values of those variables from World Bank will be taken average (i.e. FEM7085, MAL7085, LTOT7085, LFEM7085 and LMAL7085) and combined with the cross-sectional data for the estimation. Per capita GDP, gross enrollment rates at primary and secondary level are measured in their initial value instead of their average value in both savings and growth equations.

Different from the panel data analysis, as mentioned previously, due to the data limitation, only the ratio of real domestic investment in physical capital to real income is used to approximate the savings rate. In addition, variables (REVCOUP and ASSASS) used for measuring the political instability are estimated but the effects of growth rate of terms of trade will be neglected in the preliminary cross-sectional estimations.

D. Pros and Cons of Using Panel and Cross-sectional Data

In this section, the pros and cons of using panel data and cross-sectional data for estimating the effects of demographic change will be discussed.

Actually, the measurement of ageing may contribute part of the estimation biases especially in cross-section study. The dependency ratios here are defined as the percentage of female (male) population aged above 65 to the total female (male) population. The wealth of the aged population may not decline right after 65. As mentioned in Hurd (1990), wealth must decline at some age but that age is not known and it could be much greater than the retirement age. Suppose wealth would decline after 70 instead of 65, and there are large portion of population aged between

65 and 70 among the elderly. It is obvious to know that the overall savings (wealth) of the elderly would not necessarily decline. Since cross-sectional data have not measured the demographic change over time, in this case the estimation results tend to give a positive linkage between population ageing and savings. If the fraction of aged population of a country is measured as increasing over time, the fraction of elderly who start to dissave would increase at the same time. The positive biases can be improved if the data can capture the demographic change over time. At this point, panel data should perform better as it is able to capture the fraction of elderly change over time of an individual country.

However, there is an important shortcoming of both data sets when they are used to perform the impacts of demographic change: the estimation period is not long enough in term of demographic dynamics. For example, some countries experience strong baby boom that occurs just right before the beginning of the sample. In the base period of the sample, these countries will then consist of large fraction of young children. The productivity of these young children is below average or even negative on the total production. In this circumstance, per capita GDP cannot be a good proxy for the real strength of the economy even if it is measured accurately. Furthermore, the baby boom generation becomes mature and fully productive at the end of the sample, and the whole demographic structure will be much more favorable. Thus, the economic growth will be biased significantly upward.

The length of the estimation period is definitely leading a problem in estimating panel data. Compared with the cross-sectional data, the estimation period is very short in panel data analysis, only 6 continuous years. Other than the demographic factor, in that short period it is also hard to capture the effect of macroeconomic shocks on the desire of savings. For instance, if rates of return happen to be particularly high during the years of the panel, savings would increase. Similarly, if inflation happen to be particularly high, real wealth (or real savings) would decline. If the panel is sufficiently long, the actual rates of return will average out to the anticipated rate, and that average wealth change will equal anticipated wealth change.

Nevertheless, panel data can reveal some important information hidden in cross-sectional data. We can fully utilize the information to reduce the problem of collinearity and to resolve or reduce the magnitude of a key econometric problem that often arises in empirical studies. For example, panel data provides a large number of observations as to improve the efficiency of econometric estimates. By utilizing information on both the inter-temporal dynamics and the individuality of the entities being investigated, one is better able to control in a more natural way for the effects of missing or unobserved variables[9].

In this thesis, there are some difficulties on testing the robustness of the empirical results. Since Barro's cross-section data set covers the period 1970-1985, while World Bank's panel data set contains many missing data including some variables (e.g. variables used to proxy the political instability) that Barro's has in the above period, it is very hard to compare the results from two different kinds of data sets with different estimation models. If the above constraints could be eliminated, it is worth forming the same estimation models using cross-sectional data and panel data so as to compare their results and get to know more about the robustness of these empirical results.

[9] See Hsiao (1986) for details about the advantages of using panel data.

On average, non-poor countries have a larger portion of the percentage of population aged 65 or above and have a longer life expectancy than poor countries. Since the more advanced economies have much more developed pension and medical insurance schemes as well as other safety net type government programs, the savings behavior would be different compared to the less-developed economies with respect to the demographic change. Therefore, it is worth forming a sample for non-poor countries to see the significance of ageing to savings and growth. The country selection criteria are based on the availability of data in both panel and cross-sectional data sets and the development status classification that similar to O'Neill (1995). Hence, there are totally 39 and 44 countries are selected as non-poor countries samples for panel and cross-sectional data analysis respectively. Because of more data provided by the rich countries, the variables of student-teacher ratio in primary level and in secondary level are used to measure the quality of education that will be added to the estimations of non-poor countries samples. Note that there are too many missing data for poor countries, so no poor country sample is formed.

Summary statistics, definitions and data sources for all variables are given in Appendix 1, Appendix 2 and Appendix 3. Without controlling other variables, in panel data, all ageing variables (i.e. FEMALE, MALE, LTOT, LFEM and LMAL) are negatively related to physical capital investments but they are all (significantly) positively related to savings rate. The variables of life expectancy are also (significantly) positively related to per capita growth while the variables of population aged above 65 or above have insignificantly positive impacts on per capita growth. Conversely, as shown in Table 4.1, all ageing variables (i.e. FEM7085, MAL7085, LTOT7085, LFEM7085 and LMAL7085) have significantly positive impacts on both investment ratio and per capita growth in cross-sectional data. Life expectancy variables are still (significantly) positively related to savings rate. However, it is important to see whether these results still hold when other variables are controlled for.

CHAPTER 5
ESTIMATION RESULTS

I will first report the results from the OLS regression of the cross-sectional data and then from the pooling of the panel data. Afterwards, I will try to compare the results from different type of data sets with different estimation techniques. Lastly, the conflicts of the impacts of the population ageing on savings rate, that have not been solved in the previous literatures, will be reconciled in this thesis.

A. Cross-sectional Data Analysis

(i) How does ageing affect savings?

As I mentioned before in Chapter 4, only the average ratio of real domestic investment in physical capital to real income from 1970 to 1985 is used as a proxy for savings rate in the cross-sectional data analysis. The model setting in this section resembles those in Barro and Sala-i-Martin (1995). The results from Barro and Sala-i-Martin (1995) will be acted as a benchmark and will be compared with the results obtained in this empirical study.

In regression (C1) of Table 5.1, the average of female aged population over the period of 1970-85 (FEM7085) and the average of male aged population over the same period (MAL7085) are included as proxy of ageing. They exert opposite effects on savings with statistical insignificance[10]: female give negative effects while male give positive effect. However, when they are estimated separately as shown in regressions (C2) and (C3) respectively, both ageing variables give negative sign.

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[10] Actually, these two variables (FEM7085 and MAL7085) have insignificant estimated coefficients throughout the whole savings regressions even in the case of without keeping the other one controlled.

These results support the life-cycle hypothesis that population ageing and savings are negatively related due to the dissaving effect from the elderly group.

After dropping the variables of primary school enrollment ratio in 1970 and number of revolutions and coups per year[11], the estimated coefficients of the log of life expectancy are individually positively related to savings as shown in regressions (C4), (C5) and (C6). This result coincides with previous cross-sectional studies such as Barro and Sala-i-Martin (1995) that life expectancy is positively related to investment ratio. Also, this positive result support our argument that longevity and savings should be positively related because people would save more for their extended life if they expect to live longer.

In regression (C4), initial per capita income has diminishing positive impacts on the subsequent investment ratio or savings rate. This can be seen from the negative estimated coefficient of the square of initial per capita income in 1970. In this equation, secondary school enrollment ratio and government consumption exert insignificant positive effects on savings rate which depend adversely (significantly) on political instability (ASSASS). Similar results were obtained in regressions (C5) and (C6) given the value of log of female life expectancy and the value of log of male life expectancy, respectively. From regressions (C7) to (C11), the estimated coefficients of dummy variables (AFRICA and LATIN) are all insignificant which imply that the estimated savings equations have already included enough explanatory variables to explain the low savings rates in these regions.

The results for savings in non-poor countries samples, as shown in regressions (C22) to (C27) of Table 5.3, are broadly similar to those in large sample, but the

[11] It was discovered that the estimated coefficients of all explanatory variables of the whole savings regressions would be statistically insignificant. However, the statistics have been improved after dropping the variables PRI70 and REVCOUP.

estimated coefficients of ageing variables are larger in magnitude.

(ii) How does ageing affect economic growth?

In regression (C12) of Table 5.2, the variables of aged population are positively related to growth but neither one of them differ significantly from zero. However, if entering these variables separately into the equation, as in regressions (C13) and (C14), the estimated coefficients become marginally significant. Regressions (C15), (C16) and (C17) show that longer life expectancy speeds up growth.

In the basic neoclassical model, the growth rate tends to be inversely related to the absolute level of initial per capita income. This prediction receives support from the regressions in Table 5.2. Besides, growth depends negatively on government consumption and political instability but positively on initial human capital investment and the average of physical capital investment. From regressions (C18) to (C21), regional dummies are added and their estimated coefficients are significantly negative which mean that the included regressors do not well in accounting for the weak performance in these regions.

The major differences of the results for growth equation from non-poor countries samples are shown in regressions (C28) to (C32) of Table 5.3. Firstly, the positive effects of the variables of the log of life expectancy on growth become insignificant. Secondly, when variable STPRI70 is added, it shows that better initial schooling quality helps to enhance the subsequent economic growth.

B. Panel Data Analysis

(i) How does ageing affect savings?

Table 5.4 shows the pooling results when 77 countries with six continuous periods (1975-80) included. From column (1) to (7), the dependent variables are the ratio of gross domestic savings to gross domestic income from the above periods (SAVGDP). The female aged population from 1965 to 1970 has a negative impact on savings rate with strong statistical significance as shown in column (1). Same impact from the male aged population from 1965 to 1970 is shown in column (2), and even when holding other variables constant (including the percentage of female's) the negative impact on savings rate still holds, as shown in column (3). However, the female aged population becomes highly insignificant in this case, which reveals that there is a problem of multicollinearity between variables, female and male aged population. In order to reconcile this problem, these two variables would be estimated separately instead of put together in one equation.

Noted that the above results are consistent with previous studies, namely Heller and Symansky (1997), that population ageing depresses savings in the analysis of macro panel data. Again, the implication of life-cycle hypothesis in terms of macro interpretation is supported in this empirical section. The previous studies always used dependency ratios to estimate the impact of ageing on savings rate and rarely used other proxies such as life expectancy at birth in panel data analysis.

Trying to use different measurements of ageing, like in columns (4) to (6), shows that the log of total life expectancy, the log of life expectancy for female, and the log of life expectancy for male from 1967 to 1972 still have negative impacts on savings rate. These results counter to our intuition that savings should be raised as one expects to have a longer life. Column (7) puts variables female and male life expectancy together. The former one becomes insignificant while the latter one remains negative but in larger magnitude. Again, here may also have multicollinearity between these two variables and therefore they will be estimated separately.

Consider columns (1) to (3), one result is that the estimated coefficient on log of per capita GDP is significantly positive different from zero. Here gives the similar result as in Dayal-Gulati and Thimann (1997). This finding means that savings rate changes as an economy develops; however, this does not support the basic assumption in the Solow-Swan model. At the same time, the estimated coefficient of the change of growth rate of terms of trade (GRTRADE) shows that the positive terms of trade shocks increases savings through positive effect on wealth and income.

The estimated coefficient of gross enrollment ratio for primary school is (significantly) positively related to savings rate and that for secondary school is (insignificantly) negatively related to savings rate[12]. The interpretation for this result is quite puzzling. Previous studies, namely Barro (1991) indicated that enrollment ratio for primary and secondary school are both (significantly) positively related to savings. Now, it is interesting to know that higher level of human capital has a negative effect on savings. It might be due to different consumption pattern that costs differently--for example, people with higher level of education are more likely to play golf and go to the luxury places more often than people with lower level of education do. The exact reasons need to be found in further studies.

Government consumption has an insignificant adverse effect on savings rate, provided that other variables are controlled including percentage of aged population. This finding is consistent with our expectation that government expenditure would

[12] Even when entering the variables separately, the sign of the variables is the same as before.

depress savings. It will be seen in columns (4), (5) and (6) that whether the result will be changed if the variables of life expectancy are controlled instead.

The main differences in the results given by columns (4), (5) and (6) are, first, the enrollment ratio at secondary level has a significantly negative coefficient at the 5 percent level; and second, government consumption has significant adverse effect on savings rate. Thus, there is an indication that market distortions introduced by government consumption reduce the incentive to save.

From columns (8) to (12), the dependent variables are the ratio of gross domestic investment to gross domestic income from 1975 to 1980 (INVGDP), which is the proxy for savings rate. In general, the estimated coefficients of the ageing variables are similar as those with SAVGDP being dependent variable. They also exert significantly negative effects on savings rate at the usual percentage level. This time the log of female life expectancy becomes significant rather than insignificant in column (5).

Log of per capita GDP and the primary enrollment ratio are positively related savings with strong statistical significance throughout columns (8) to (12). There are three major differences compared with the results from SAVGDP being dependent variables. Firstly, the secondary enrollment ratio is (significantly) negatively related to savings that still hold even in the case of keeping the aged population variables constant. Secondly, government consumption has stronger negative effects than before. It might imply that investment is much sensitive to the government decision and therefore greater distortion from government consumption would exert greater negative impact on investment ratio. Thirdly, the growth rate of terms of trade becomes negative and insignificant.

Considering the Buse Raw-moment R^2 in the estimations of savings rate and investment ratio, the values of R^2 given in the latter one is very close to that in the former one. The estimation results obtained from using investment ratios as proxy of savings should be reliable.

Columns (13) to (22) include regional dummy variables for sub-Saharan Africa and Latin America. The perspective is similar as in Barro and Sala-i-Martin (1995) that, if we have already included enough explanatory variables to explain why savings rate was below expectations in sub-Saharan Africa and Latin America, then the estimated coefficients of the dummy variables would differ insignificantly from zero.

From columns (13) to (17), the dependent variables are SAVGDP. The estimated coefficients of sub-Saharan Africa and Latin America dummies are significantly negative in columns (13) and (14). Only dummy sub-Saharan Africa is significant in columns (15), (16) and (17) in which the life expectancy variables are controlled for rather than controlling the variables for the aged population. On the other hand, from columns (18) to (22), the dependent variables are INVGDP. Both regional dummies are statistical insignificant at usual critical values. Thus, the included regressors in INVGDP explain better in accounting for weak savings performances in both sub-Saharan Africa and Latin America relative to those regressors in SAVGDP.

Table 5.5 reports the results from pooling the data of non-poor countries sample, which has totally 39 countries. The dependent variables are SAVGDP and INVGDP for columns (23) to (32) and columns (33) to (42), respectively. In general, the results from the small sample are similar to those from the large sample. The major difference from the large sample is that the variables of the student-teacher ratios for primary and secondary school are added as the proxies for the quality of education in the small sample. Variables of schooling quality are added into columns (25) and (26). As a whole, the sign and the significance of the independent variables are the same as in columns (23) and (24), except the enrollment ratio of primary school, which is insignificant.

In columns (25) and (26), keeping other variables constant including the variables for aged population, better quality in primary school gives lower savings rate while better quality in secondary school enhances higher savings rate[13]. This is the second puzzling question about the impact of human capital on savings. The high quality of schooling is more likely to be found in a well-developed economy with high per capita income, which is positively correlated with savings. It may imply that the productivity of a worker with better quality of human capital should be higher, given other things constant, including the quantity of schooling. Now the findings show that only better quality of schooling in secondary level would enhance savings. This interesting finding gives us an insight about the cost and benefit of provision of better quality of schooling in different levels. Provision of better quality of schooling is normally with higher cost. The ability of gaining knowledge of students at primary-school age is relatively low and their contribution to the society is relative less. As a result, the cost of provision of higher quality of primary schooling will exceed its benefit. On the contrary, students at secondary-school age grow to be more mature and their ability of learning is higher, absorbing wider knowledge. Plus, their contribution to the society is relatively higher. Therefore, the cost of provision of higher quality of secondary schooling will be covered by its benefit.

When controlling the variables for log of life expectancy as shown in columns (27) to (32), the estimated coefficients for the secondary student-teacher ratio

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[13] Even when the variables are entered into the model separately, the sign of the variables remains the same.

become insignificant. Keeping other things constant, columns (30) to (32) show that better quality of schooling in primary level still gives a negative impact on savings, while better quality of schooling in secondary level gives a positive impact on savings.

Comparing the results from the non-poor countries sample (columns (23)-(24) and columns (27)-(29)) with those from the large sample, the variables of log of life expectancy, log of per capita GDP, government consumption and the growth rate of terms of trade exert larger effects on savings rate. This result remains the same even after holding the quality of schooling constant. From columns (33) to (42), the sign of the estimated coefficients are the same as those in the large sample but the magnitude of the impacts of the log of life expectancy and government consumption on the investment ratio (or savings rate) are larger. It can be understandable because the portion of aged population in non-poor countries is larger than that in the rest of the world, and hence its impacts on savings should be more significant. Besides, the findings also show that savings rates in more advanced countries are more sensitive to the change of income, government distortion and the external shocks.

Here is an interesting findings drawn from columns (23) to (42): no matter what dependent variables (either SAVGDP or INVGDP) and ageing proxies (either aged fraction or life expectancy) used, the negative impact of male aged population is consistently greater than that of female's on savings in non-poor countries. Does it imply the consumption of aged male is larger than that of aged female? Or, does it mean the savings ability of aged female is higher than that of aged male? Other than this finding, the statistic Buse Raw-moment R^2 in non-poor countries sample is generally greater than that in full sample.

(ii) How does ageing affect economic growth?

Table 5.6 shows the results of pooling for growth rate of real per capita GDP from 1975 to 1980. We first consider columns (43) to (49), keeping other variables constant including SAVGDP, as we expected, ageing population speeds up economic growth. The percentage of aged population and life expectancy both give positive estimated coefficients.

Columns (43) and (44) show that primary and secondary school enrollment ratios have positive effects on the per capita growth rate which also depends positively on savings rate and the growth rate of terms of trade. The economic growth depends inversely (significantly) on the log of per capita GDP as well as (insignificantly) on the government consumption, which are drawn from the same period. All these findings are consistent with our expectations.

In order to understand more about the influences of government spending to the future economic growth, observations from preceding six periods (1967-74) are used instead of 1975-80. Another interesting result is obtained in columns (45) to (49) that government consumption has a positive effect to the future economic growth with strong statistical significance. It can be explained this way: government spending on certain items such as building infrastructure systems that could help with the future economic development. Replacing aged population with life expectancy as shown in columns (47) to (49), human capital variables become negative. The estimated coefficients of primary school enrollment ratio are significant, while that of secondary school enrollment ratio are insignificant. This result is quite puzzling because it is counter to our intuition that human capital investment is the engine of growth.

We now turn to consider columns (50) to (56), keeping other variables constant including INVGDP instead of SAVGDP, both the aged population and the log of life expectancy also exert positive effects, but the estimated coefficients for the aged population still differ insignificantly from zero. From columns (54) to (56), same human capital investment puzzling question raises again. Economic growth also depends positively on investment ratio as we expected.

Columns (57) to (62) include regional dummy variables for sub-Saharan Africa and Latin America. All dummy variables are (significantly) negatively related to the per capita growth rate. It means that the estimated growth equations have not included enough explanatory variables to explain why growth rate was below expectations in sub-Saharan Africa and Latin America. The missing explanatory variables may be those used to proxy the political instability that induce market distortions and hence affect economic growth.

Table 5.7 reports the results of non-poor countries sample that pooling for the growth rate of real per capita GDP from 1975 to 1980. Similar as in savings equation, the major difference from the large sample is that the variables of the student-teacher ratios for primary and secondary school are added as the proxies for the quality of education in the small sample. Better quality in secondary school speed up economic growth, which is indicated in columns (66)-(68).

From columns (63) to (68), the variable SAVGDP is controlled for. Without controlling the ratios of student-teacher in primary and secondary school as shown in columns (63), (64) and (65), they show that there is a positive linkage between the life-expectancy at birth and the economic growth. Besides, the magnitude of the effects on growth from the male life expectancy is greater than that from the female life-expectancy by one-fold. It might be because the productivity of male in non-poor countries is higher. When males' life expectancy get longer, their contributions to the society may be more.

After controlling the student-teacher ratios as indicated in columns (66), (67) and (68), the positive linkage between ageing variables and per capita growth still holds. As discussed previously, quality of schooling in secondary level is positively related to savings. Here the findings also show that better quality of education for secondary school helps to speed up the economic growth. However, the impact of the schooling quality in primary level on the economic growth still uncertain here as its estimate is insignificance at the usual percentage level.

The results from controlling INVGDP (from column (69) to (74)) are more or less the same as those results from controlling SAVGDP. Compared with the large sample for growth, as a whole, the sign of the estimated coefficients of the growth rate of terms of trade is changed from positive to negative. According to the Buse Raw-moment R^2, the goodness of fit of the data has been improved in non-poor countries sample from the large sample.

C. Comparison between the Results from the Analyses of the Cross-sectional Data and the Panel Data

In this section, I will focus on the performance of population ageing in savings and growth equation for cross-sectional and panel data analyses. Considering the impact on savings, fraction of aged population in both cross-sectional and panel data depress savings as required by life-cycle hypothesis. This finding confirms the results in previous study with macro-panel data such as Heller and Symansky (1997) even though using different definition of dependency ratios. For example, previous macro-panel studies always use the old-aged dependency ratio as a proxy of ageing and they have not distinguished its effect by gender. However, in this empirical study, sex differential in fraction of aged population is considered.

Obtaining from the cross-sectional data, longevity exerts a positive impact on savings. Again, this finding also confirms the results in a previous study with macro-cross-sectional data such as Barro and Sala-i-Martin (1995). However, this positive relationship does not hold in the case of panel data analysis, which show that life expectancy at birth depresses savings. This inconsistent result will be discussed in details in the following sections. Nevertheless, compared with panel estimates, cross-sectional estimates suggest a stronger link between demographic variables and savings.

Considering the impact on growth, ageing variables give consistent positive results in both panel and cross-sectional data in the full sample. They suggest that population ageing does speed up growth. Apart from these, there is again an interesting finding: the absolute magnitude of male demographic variables is greater than that of female demographic variables in both savings and growth equation for non-poor countries sample. That is, the influence of aged male is greater than that of aged female on savings and economic growth in more advanced economy. This may suggest that the productivity of male is still greater than that of female in the labor market.

D. Reconciliation between the Conflicts

What are the conflicts existing in the study of the impacts of population ageing on savings? There are two major conflicts that we want to reconcile in this empirical study. One is from the previous literatures and the another one is from the preliminary empirical results of this paper.

The empirical findings obtained from the previous literatures about the impacts of ageing on savings do not come to a consensus. Some studies show that population ageing should depress savings, which supports the life-cycle hypothesis. On the contrary, some studies show that ageing and savings should be positively correlated, which supports our conventional wisdom. In fact, there is a common area in their estimation models, separately. The former group uses "dependency ratio" to estimate the impacts of ageing, while the latter group uses "life expectancy at birth" or "longevity" instead. When we look carefully about the interpretations of these two variables, we can understand why the previous studies give ambiguous results about the relationship between ageing and savings.

Dependency ratio refers to the fraction of aged population, which captures the change of age structure of the economy. The increase of this ratio represents that the age structure of the economy is shifting from young to old. According to one of the implications of the life-cycle hypothesis, elderly will dissave after retirement. When the percentage of the old-aged population gets larger, the dissaving effect from the elderly group becomes greater and hence savings rate of the economy will be declined as well. That is why some previous studies such as Heller and Symansky (1997), which use dependency ratio, show that there is a negative relationship between ageing and savings.

In contrast, the interpretation of life expectancy at birth is a bit different, as it does not involve the concept of age structure. Life expectancy at birth only tells us that the longevity of an individual. No matter how old is an individual, he / she will save more in response to the extension of his / her life. In other words, even for an economy with low life expectancy at birth, say 50 which is not classified as old-aged, savings of the economy will be enhanced when its life expectancy at birth is extended. This reason explains why some previous empirical works such as Barro and Sala-i-Martin (1995), which use life-expectancy at birth, show that there is a positive linkage between ageing and savings.

Nevertheless, there is a shortcoming of just putting either dependency ratio or life expectancy into the model. When the effect of longevity on savings is measured, the age structure of the economy should be controlled for and vice versa. In order to have a better estimation of the impacts of ageing on savings, both variables, fraction of aged population and life expectancy at birth, should be entered together into the model. The empirical results for this part will be presented in part (d) of this chapter. It will be interesting to see whether the sign and the statistical significance of the estimated coefficients of the ageing variables will be changed after controlling the other one.

The second struggling matter is that the estimation results are not consistent from the cross-section data and the panel data. For cross-sectional data, life expectancy has been shown to have a positive relation with savings in full sample and in non-poor country sample. However, for panel data, the opposite statistically significant results are acquired not only in full sample but also in non-poor country sample. The following sections will focus on discussing what are the possible reasons that cause the differences. This paper also aims to reconcile the inconsistencies by doing different experiments, to have a deep and thorough explanation on the matter.

(i) Difference in the length of estimation periods

It has to be noted that the estimated models in cross-sectional data analysis are different from those in panel data analysis. The lengths of estimation period are not identical either. Cross-section estimates the average of savings rate over the period

1970-85 while panel estimates the yearly continuous data from 1975-80, which is only part of the cross-section estimated period. Thus, the estimation results of the impacts of ageing on savings over two different estimation periods with different models are not necessarily the same.

Now, the signs of the ageing variable, life expectancy at birth, are different in panel data analysis and cross-sectional data analysis. This may be due to the variations happened during the periods that panel data analysis has not considered. In other words, for cross-sectional data, during the periods of 1970-74 and 1981-85, longevity and savings might have a positive relationship. Supposed that longevity and savings are negatively related, as shown in panel data analysis, during the period of 1975-80. The negative relationship would be cancelled out or faded off after taking the average over the whole period of 1970-85. As a result, cross-sectional data analysis will give a positive linkage between longevity and savings even if they are negatively related in a certain period of time

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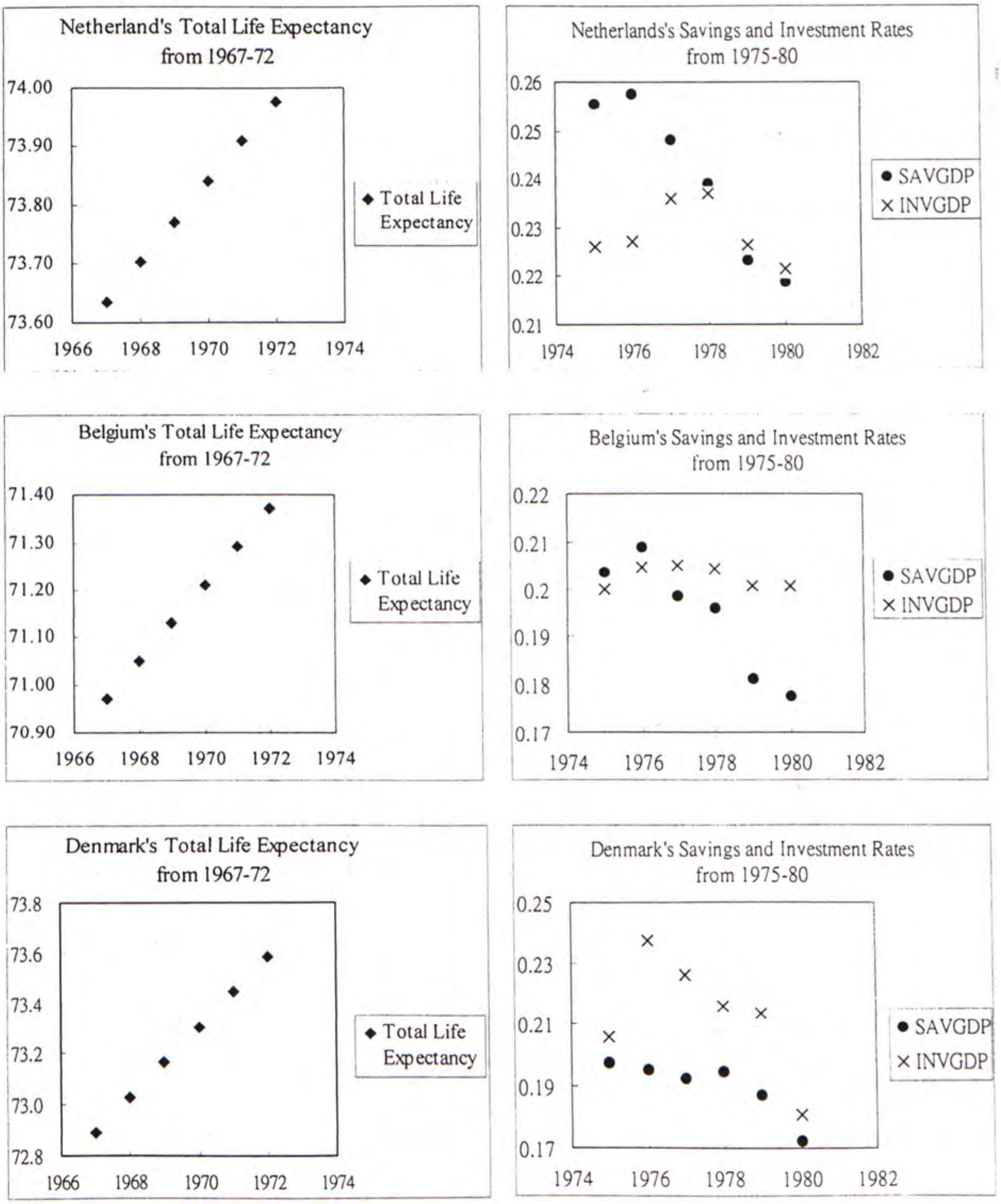
(ii) Cross-sectional Effect vs. Time Series Effect

Since panel data provide the information about the variations of data from country to country and the variations over time, there are cross-sectional effect and time series effect that would affect the pooling results. Which effect would dominate at the end? Given estimating on the same period of time with same model, if the cross-sectional estimation gives positive results while the pooling gives negative results, it will imply that the time series effect dominates the cross-sectional effect and vice versa.

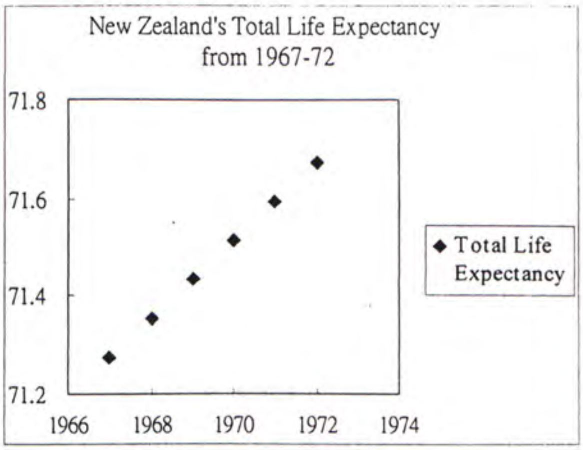
The idea of time series effect can be roughly grasped by plotting the interested variables against time. As illustrated in Figure 6, countries in the full pooling sample (the one with 77 observations) with large fraction of aged population are selected, which includes Netherlands, Belgium, Denmark, New Zealand, Sweden, United Kingdom, France, Austria, Italy, Germany, Japan and United States. Total life expectancy at birth from 1967 to 1972 and savings rate and its proxy investment ratio from 1975 to 1980 are plotted against time. Although the period of time covered by ageing variables and savings variables are not the same, the relationship between these two variables over time can be seen because the preceding values (i.e. data from 1965-70) can reflect the trend of ageing[14]. Total life expectancies at birth of those selected countries are increasing over time, while savings rates are decreasing in most countries. For some countries, such as Japan, the savings rate goes up and down throughout the period, but the magnitude of downward trend is larger than that of upward trend. Concluded by graphical inspection, it seems that longevity and savings are negatively related over time, which is called as "negative time series effect".

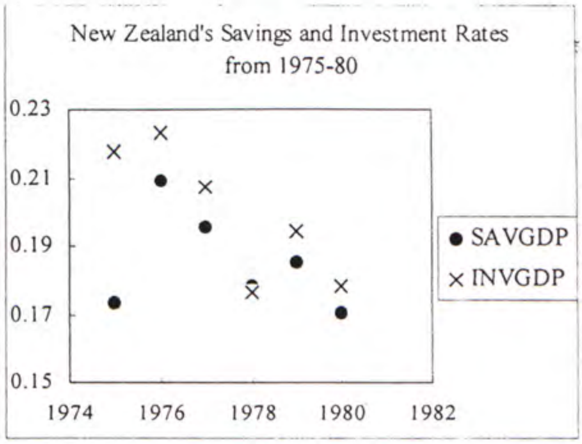
[14] During the period of 1975-80, data for ageing variables are very insufficient (only data in 1975 and 1980). I have plotted savings rate and the fraction of aged population of the selected countries over the entire period of time, 1960-93, with World Bank Data 1995. As shown in Appendix 5 (Figures 7 and 8), ageing and savings in the case of U.S. and Germany seem to have a negative relation.

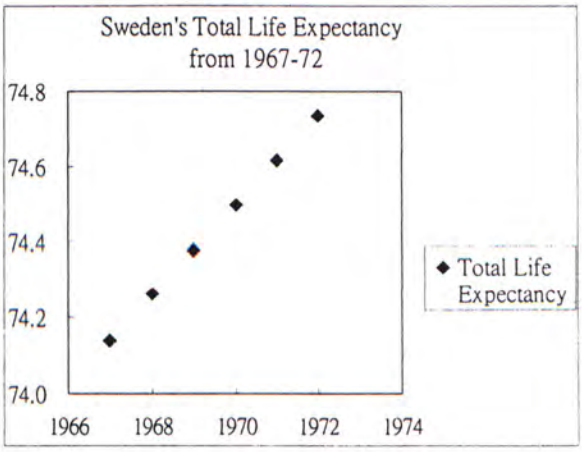
Figure 6: Total life expectancy at birth from 1967-72 and Savings and Investment Rates from 1975-80

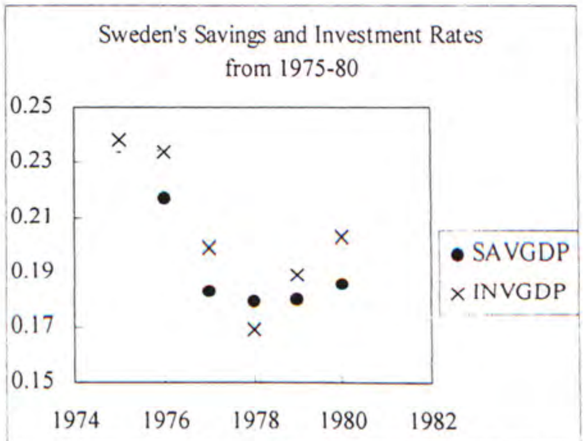


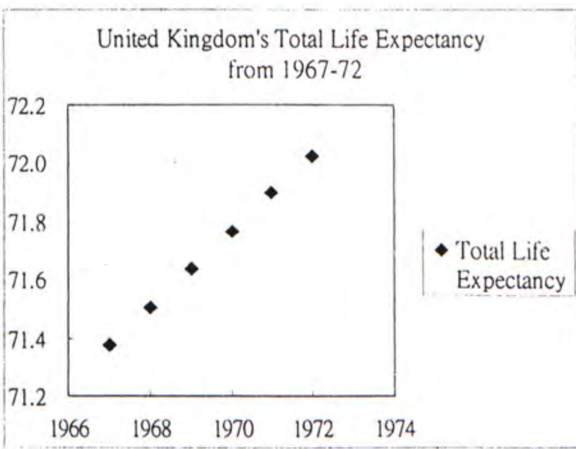
Key:
FEMALE = Fraction of female aged population
MALE = Fraction of male aged population
SAVGDP = Ratio of domestic savings to GDP in real term
INVGDP = Ratio of domestic investment to GDP in real term

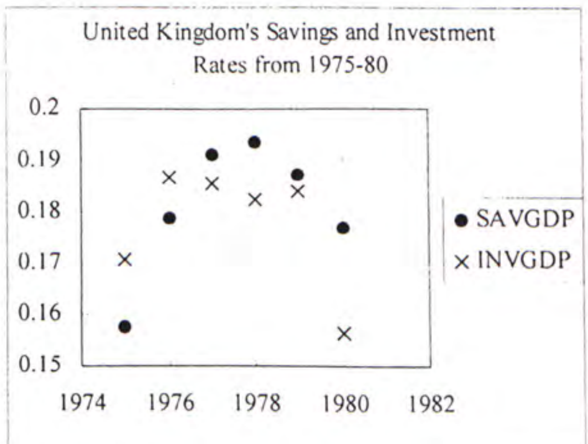

New Zealand's Total Life Expectancy
from 1967-72
71.8
71.6
71.4
71.2
1966
1968
1970
1972
1974
Total Life Expectancy

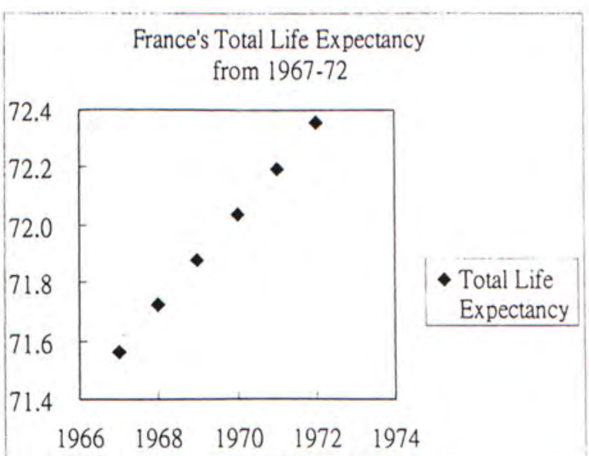

New Zealand's Savings and Investment Rates
from 1975-80
0.23
0.21
0.19
0.17
0.15
1974
1976
1978
1980
1982
SAVGDP
INVGDP

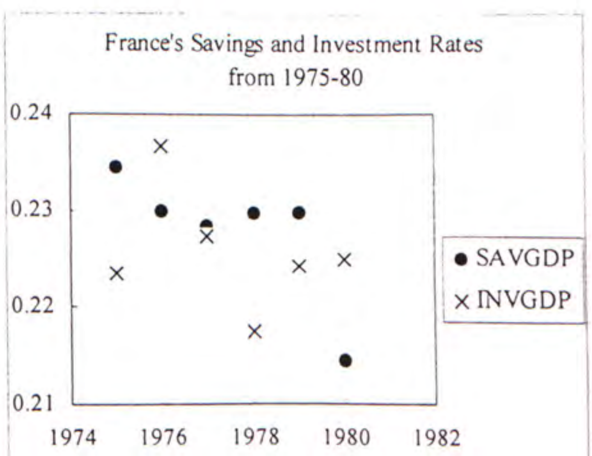

Sweden's Total Life Expectancy
from 1967-72
74.8
74.6
74.4
74.2
74.0
1966
1968
1970
1972
1974
Total Life Expectancy

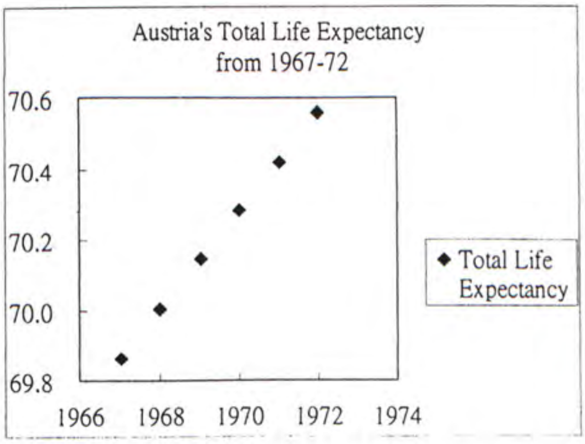

Sweden's Savings and Investment Rates
from 1975-80
0.25
0.23
0.21
0.19
0.17
0.15
1974
1976
1978
1980
1982
SAVGDP
INVGDP

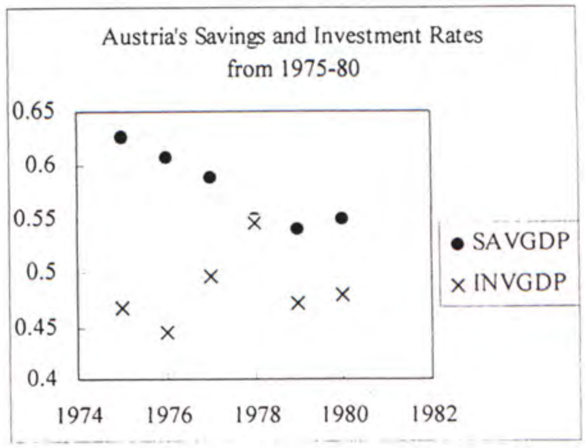

United Kingdom's Total Life Expectancy
from 1967-72
72.2
72.0
71.8
71.6
71.4
71.2
1966
1968
1970
1972
1974
Total Life Expectancy

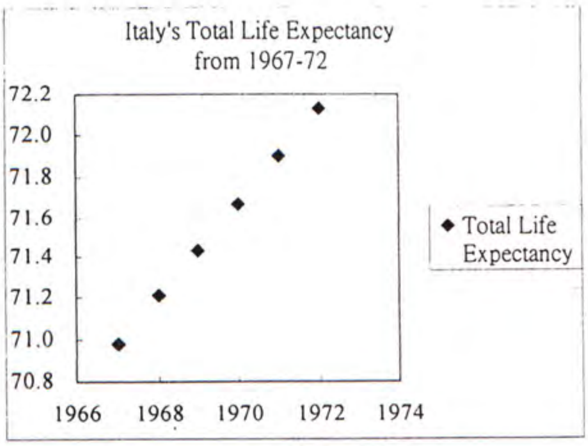

United Kingdom's Savings and Investment
Rates from 1975-80
0.2
0.19
0.18
0.17
0.16
0.15
1974
1976
1978
1980
1982
SAVGDP
INVGDP


France's Total Life Expectancy
from 1967-72
72.4
72.2
72.0
71.8
71.6
71.4
1966
1968
1970
1972
1974
Total Life Expectancy

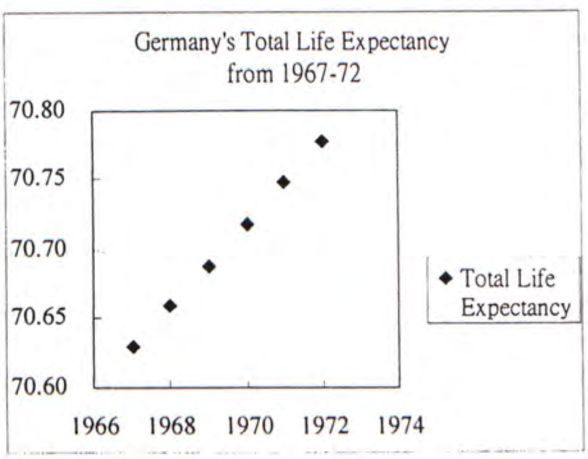

France's Savings and Investment Rates
from 1975-80
0.24
0.23
0.22
0.21
1974
1976
1978
1980
1982
SAVGDP
INVGDP

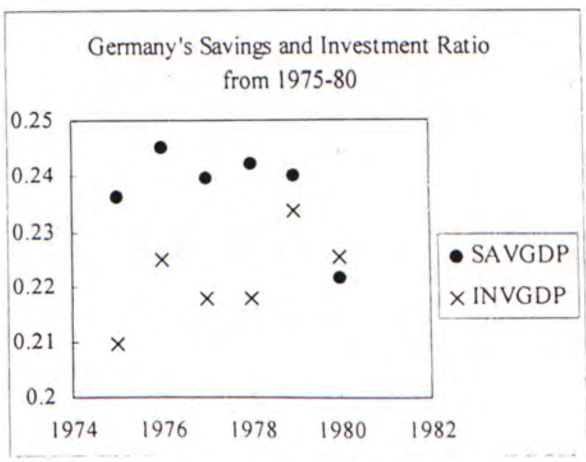

Austria's Total Life Expectancy
from 1967-72
Total Life Expectancy

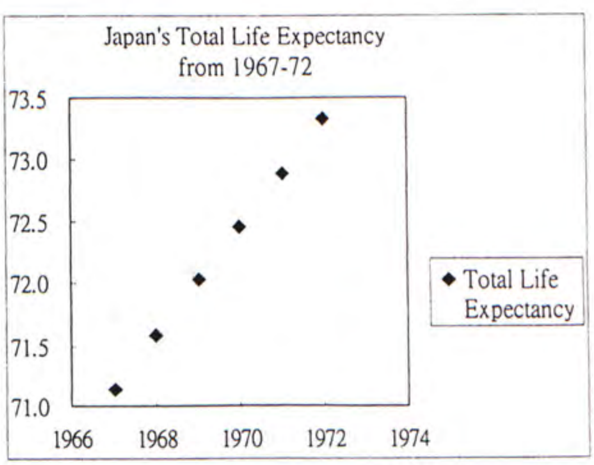

Austria's Savings and Investment Rates
from 1975-80
SAVGDP
INVGDP

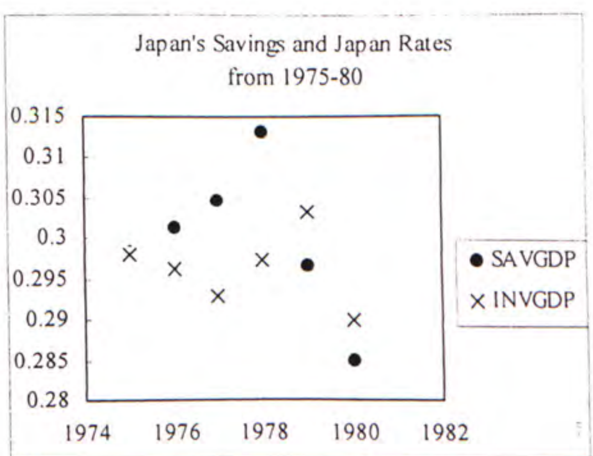

Italy's Total Life Expectancy
from 1967-72
Total Life Expectancy

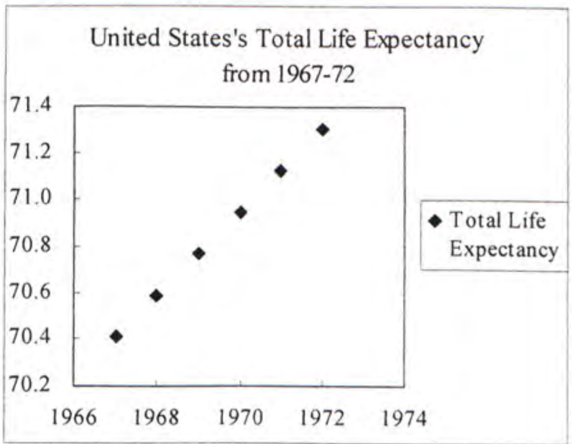

Italy's Savings and Investment Ratio
from 1975-80
SAVGDP
INVGDP

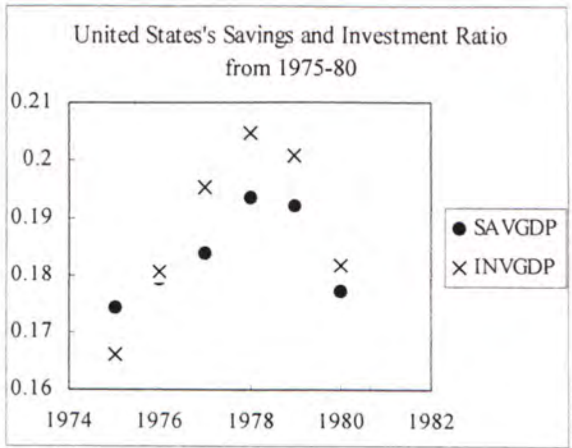

Germany's Total Life Expectancy
from 1967-72
Total Life Expectancy


Germany's Savings and Investment Ratio
from 1975-80
SAVGDP
INVGDP


Japan's Total Life Expectancy
from 1967-72
Total Life Expectancy


Japan's Savings and Japan Rates
from 1975-80
SAVGDP
INVGDP





To distinguish the effect of cross-section from pooling, data from the panel data analysis will be estimated cross-sectionally. The following basic model will be used, so that the results can be comparable.

Savings $=\alpha_0 + \alpha_1$ log(real per capita GDP) + α_2 gross enrollment ratio for primary level + α_3 gross enrollment ratio for secondary level + α_4 government consumption + α_5 growth rate of terms of trade + α_6 population aged above 65 or log (life expectancy at birth)

Tables 5.8 and 5.9 summarize the sign and the significance of the estimated coefficients for the ageing variables for the full sample (totally 77 observations) and the non-poor country sample (totally 39 observations) respectively from the year 1975-80. As a whole, the signs of the fraction of aged population are unanimously negative. Although they are mostly insignificant, the tendency of the negative impacts on savings has been reflected with the signs. However, during the period of 1978-80, life expectancy variables turn to indicate the positive effect on savings with statistical insignificance, but they are (significantly) negatively related to savings before the above period. Therefore, the effect of cross-section cannot be sure whether it is positive or negative, but it has a great tendency to be negative for sure owing to the significance of the estimates.

When pooling the panel data, the empirical result gives the negative link between longevity and savings. There are two possibilities that raise the above result. One is that, suppose that there is positive cross-sectional effect, the negative time series effect dominates the cross-sectional effect. The another one is that, suppose that there is a negative cross-sectional effect, both the negative time series effect and the negative cross-sectional effect reinforce the negative influence of longevity on savings. Based on the above empirical findings, we cannot determine which possibility causes the difference of the impacts of longevity on savings in panel data and cross-sectional data analyses. In other words, there is no sufficient evidence to say time-series effect dominates cross-sectional effect or the another way round. Thus, in order to figure out the reason, we turn to focus on the sampling problem.

(iii) Sampling Problems

The number of country, the countries involved and the estimated models are not identical in different samples with different kind of data sets, which are the major factors that may cause the discrepancy of the empirical findings. For example, for panel data, there are 77 countries involved in the full sample while, for cross-sectional data, there are 91 countries involved in the full sample instead. In the meantime, the countries involved are not exactly the same, some in one sample but not in another one and vice versa.

Apart from these, the estimated model in the panel full sample is a bit different from that in the cross-sectional full sample. For instance, the variable, growth rate of terms of trade, is entered into the former model but it is not entered into the latter model. Similarly, variables used for measuring the political instability are not entered into the former model but it does in the latter model. Other than the above factors, it is also plausible that the existing outlier countries in the sample cause the discrepancy. Therefore, owing to the above four factors that cause the sampling problem, the results from the estimated models are not necessarily the same.

In order to fix the sampling problems, the number of country, the countries involved and the number of exogenous variables in the model will be controlled. Firstly, to cut the outliers, the samples are taken 10% trim. The number of countries in full sample for cross-section and panel becomes 82 and 70, respectively. Similarly, the number of countries in non-poor country for cross-section and panel becomes 40 and 35, respectively.

Secondly, to control the number of country and the countries involved, those countries present in both samples will be selected so that the countries selected and the number of country in both samples will be dependent and identical. Eventually, there are 67 and 33 countries in full sample and non-poor country sample, respectively, for both data sets.

Finally the independent variables are controlled as well by entering the same variables into the models for both data sets. The major model is the followings:

Savings = $\alpha_0 + \alpha_1$ log (per capita GDP at initial year) + α_2 Primary school enrollment ratio at initial year + α_3 Secondary school enrollment ratio at initial year + α_4 government consumption + α_5 growth rate of terms of trade + α_6 percentage of aged population or log (life expectancy at birth)

(a) Results from cutting outliers (full samples)

We will mainly focus on the impacts of ageing variables on savings after controlling the above factors. Table 5.10 shows the regressions for savings of cross-sectional data in full sample, in which regressions (C33) to (C42) the ageing variables are entered separately. From regressions (C33) to (C37), ageing variables are taken its average value over the period 1970-85. The estimated coefficients of fraction of aged population give a negative sign while that of life expectancy at birth give a positive sign, which confirm our expectation. However, compared to regressions (C4) to (C6), the estimated coefficients of life expectancy become statistically insignificant and their magnitude turn to be smaller. This may be due to large reduction in number of observations for regression. In general, the sign of the rest of independent variables is consistent with the previous results (i.e. results in Table 5.1).

The negative effect from the aged fraction and the positive effect from the life expectancy on savings still hold even when using their initial values instead in regressions (C38) to (C42). Besides, according to the adjusted R^2, the goodness of fit seems to be improved compared with those samples without cutting the outlier countries.

Table 5.11 shows the results from pooling the panel data for savings rates for 67 countries from 1975-80 with dependent variable SAVGDP. Six continuous yearly data for all independent variables are estimated in columns (75)-(79). All ageing variables give significantly negative impact on savings, which is similar to those previous without cutting the outliers.

From columns (80) to (84), the initial values (i.e. values in 1975) of per capita GDP, primary school enrollment ratio, secondary school enrollment ratio are used. The negative impacts of all ageing variables still hold. Similar situations also happen in the case of replacing investment ratio (INVGDP) as the dependent variable, as shown in columns (93) to (102).

Considering other exogenous variables, per capita GDP, primary school enrollment ratio and growth rate of terms of trade keep exerting positive impacts on savings, which depend negatively on secondary school enrollment ratio and government consumption as well. Therefore, there is no difference between the results from with and without cutting the outiers observations for the sign of the estimated coefficients in savings equation (for panel data).

Table 5.12 indicates the results from pooling for savings rate for 67 countries from 1975-80 with investment ratio as the dependent variable. All ageing variables are shown to have negative influence on savings, which are statistically significant at the 5 per cent level. Compared to the case of without cutting the outliers (columns (8)-(12)), there is no significant difference with the sign of all estimated variables. From columns (98) to (102), estimating the initial values of per capita GDP and school enrollment ratios instead, the impacts of ageing are same as those obtained from columns (93) to (97). However, the estimated coefficients of per capita GDP at 1975 becomes negative (insignificant) while secondary school enrollment ratio at 1975 becomes positive (insignificant). Besides, throughout columns (93) to (102), the estimated coefficients of growth rate of terms of trade change from negative to positive, which differ insignificant from zero.

Compared to those in columns (93) to (102), the estimated coefficients in columns (75) to (84) are greater in absolute magnitude. This implies that the impact of population ageing exerts a greater impact on savings (SAVGDP) than that on investment ratio (INVGDP).

(b) Results from cutting outliers (non-poor country samples)

Table 5.13 gives the results of regressions for savings of cross-sectional data for non-poor countries. Similar to those from full sample, as shown in regressions (C51) to (C55), fraction of aged population remains to have a negative impact on savings while life expectancy at birth still exerts a positive impact on savings. These are also true even when using the initial conditions of the ageing variables instead, as shown in regressions (C56) to (C60). The results are consistent with our expectation.

In regressions (C61) to (C65), student-teacher ratios in 1970 for primary and secondary level are entered into the model. It can be seen clearly that the sign of the right-hand-side variables, including ageing variables, do not change even after adding the quality of schooling.

Two things concerning non-poor country sample with cross-sectional data should be noted. The first thing is that most of the estimated coefficients are statistically insignificant at the usual percentage level. In fact, even in the full sample (for cross-sectional data), with or without cutting outliers, insignificance of the estimates also exist. Therefore, joint tests are performed in order to test whether the estimates are jointly statistically significant. Fortunately, the F-statistics show that they are jointly statistically significant at the usual percentage level.

The second thing is that the adjusted R^2 in non-poor country sample is very small. This indicates that the observations do not fit well on the regression line. Since the number of observations is too few, it is one of the causes to induce insignificance of the estimates and give the small goodness of fit.

Table 5.14 gives the results of pooling for savings rate for 33 non-poor countries from 1975-80 with dependent variable SAVGDP. Fraction of aged population is shown to depress savings as we expected, which is also true when controlling the quality of schooling as indicated in columns (113) and (114). On the contrary, life expectancy at birth is shown to enhance savings that confirms our intuition, which is still supported even after controlling the quality of schooling as indicated in columns (118) to (120). It is so delightful to obtain these results which are not only consistent with those from estimating Barro data but also further confirm our hypothesis that fraction of aged population and life expectancy at birth should exert opposite influence on savings as they represent different things indeed.

Other than this surprising result, two more desirable results about the impacts of human capital on savings are acquired in estimating the non-poor countries sample for panel data. The first one is that secondary school enrollment ratio becomes significantly positive as shown in columns (111) to (120), compared with columns (23) to (32). Previously, enrollment ratios for primary and secondary schools have been shown to exert opposite effects on savings, which is very puzzling as it counters to our intuition that they should give more or less the same impacts, at least giving the same sign. Now, it is so pleased to acquire the consistent positive sign for human capital variables, which also confirms the results from previous studies such as Barro and Sala-i-Martin (1995).

The second one is that variables for measuring the quality of schooling give unanimous results that better quality in provision for schooling no matter in primary level or in secondary level would enhance economy savings, as shown in columns (113)-(114) and (118)-(120). Recalling the previous results in columns (25)-(26) and (30)-(32), quality of schooling in primary level is shown to be positive while that in secondary level is shown to be negative. Now, student-teacher ratios in both levels are shown to be negative that reconciles our puzzling question, which has been shown previously that better quality in primary level would depress savings. These wonderful results are value added to this thesis and make a great progress on estimating the impacts of ageing on savings.

Similar results can be obtained in the case of using the investment ratio (INVGDP) as the proxy of savings, as indicated in columns (125) to (134) of Table 5.15. There is only one discrepancy between the result obtained from SAVGDP and INVGDP. The sign of per capita GDP is negative in the case of INVGDP rather than positive as in the case of SAVGDP.

(c) Results from entering both ageing variables together (full samples)

As discussed at the beginning of section D in this chapter, both fraction of aged population and life expectancy at birth should be entered together into the model, so that the interpretation of their estimated coefficients will be more valid and plausible. That is, in order to have a suitable interpretation, the effects of changing age structure of the economy and the extension of human life should be controlled for at the same time.

In Table 5.10, regressions (C43) and (C44), fractions of aged population exert a negative impact while total life expectancy at birth exerts a positive impact on savings, which is also true even when using their initial value at 1970 instead, as shown in regressions (C45) and (C46). Moreover, even after controlling the regional dummy, sub-Saharan Africa and Lain America, the expected opposite signs of aged population and longevity are obtained, as shown in regressions (C47) to (C50).

In Table 5.11, from columns (85) to (88) show the corresponding results obtained from pooling the panel data. Unfortunately, the expected sign cannot be acquired even when entering both ageing variables together into the model. Fractions of aged population and total life expectancy both have a negative impact on savings although their effects have been controlled for each other. This unexpected negative relationship is still supported even after controlling regional dummy as shown in columns (89) to (92). Similar circumstances are retained in the case of using the investment ratio, INVGDP as the proxy of savings, as shown in columns (103) to (110) of Table 5.12.

(d) Results from entering both ageing variables together (non-poor countries sample)

In Table 5.13, regressions (C66) to (C71) shows the results from estimating cross-sectional data for non-poor countries given controlling both ageing variables at the same time. Similar to those obtained in full sample, negative impact from fractions of aged population and positive impact from total life expectancy are acquired, which is also true even when holding the quality of schooling constant, as shown in regressions (C70) and (C71).

In Table 5.14, columns (121) to (124) shows the results from estimating panel data for non-poor countries given controlling both ageing variables at the same time. Again, it is very delighting to have a great breakthrough in this research. The ageing variables give expected opposite signs, which not only confirms the results from previous literatures but also further confirms our hypothesis that increase in fraction of aged population should depress savings while extension in human life should enhance savings. Meanwhile, the interpretation of the result is appropriate as the effects of both ageing variables have been controlled for.

The above delighting results are further improved after controlling the quality of schooling as indicated in columns (123) and (124). The estimated coefficients of fractions of aged population and the total life expectancy exert a significant influence on savings. Similar corresponding results can be obtained from INVGDP as the dependent variable, as shown in columns (135) to (138). This time the estimated coefficients of ageing variables are statistically significant at the usual percentage level, which is true in the case of with and without controlling the quality of schooling.

E. Further Examination on the Impact of Ageing on the Economic Growth

In this section, we will take further examination on the impact of ageing on the economic growth by entering the ageing variables, fraction of aged population and the total life expectancy at birth together into the growth model. As discussed earlier, the importance of controlling these two ageing variables at the same time should not be neglected, and in fact they perform differently before and after entering them together into the savings model. It is found that, after controlling each other, fraction of aged population gives negative impact while total life expectancy at birth gives positive impact on savings. This result is consistent among the non-poor country samples from cross-sectional data to panel data. Therefore, it is interesting to see whether the ageing variables will perform differently after entering them together into the growth model and they will give the corresponding signs as in savings model. Besides, if the ageing variables perform consistently in both savings and growth models, we can further confirm that population ageing affects the growth of the economy via savings.

Table 5.16 further shows the results for growth rate of per capita GDP with cross-sectional data. Recall that fraction of female aged population, fraction of male aged population and the total life expectancy at birth are positively (significantly) related to growth when they are entered into the model separately, as shown in regressions (C13) to (C15). Regressions (C72) and (C73) show the results of controlling both ageing variables at the same time in the full sample with 91 observations. It is found that fractions of aged population and the total life expectancy at birth are positively (significantly) related to growth. This positive relationship is still true even when controlling the regional dummy, as shown in regressions (C74) and (C75). However, the total life expectancy turns to be negative while fractions of aged population remain positive in non-poor country sample as indicated in regressions (C76) and (C77). As the unexpected negative sign given by the total life expectancy is statistically insignificant, it can be ignored at this stage.

Table 5.17 further shows the results for growth rate of per capita GDP with panel data for 77 countries from 1975 to 1980. When the ageing variables are entered separately into the model as shown in Table 5.6, they all are positively related to growth rate of per capita GDP. Now the positive linkage between ageing variables and the growth still holds even when entering them together into the model as shown in columns (139) and (140) with saving ratio as one of the explanatory variables. However, after controlling the regional dummy, it is found that fractions of aged population give the insignificant negative impact on growth while total life expectancy at birth gives the significant positive impact on growth, as shown in columns (141) and (142). Similar results can be acquired when investment ratio is used instead of placing saving ratio at the right-hand-side of the model, as shown in columns (143)-(146).

The corresponding results for non-poor country samples are shown in Table 5.18. It is found that fractions of aged population perform differently by gender as indicated in columns (147) and (148) when they are entered into the growth model separately and saving ratio is controlled in the model. Female fraction of aged population has a negative linkage with growth while male fraction of aged population has a positive linkage in which the estimated coefficients of these variables are statistically insignificant. When the ageing variables, fractions of aged population and the total life expectancy at birth are entered together into the model as shown in columns (149) and (150), their signs have not changed. We can obtained more or less the same empirical results when investment ratio is used instead of savings ratio as shown in columns (151) to (154). Here there is only one big difference from before: the estimated coefficient of the male aged fraction gives a negative sign with statistical insignificance (in column (154)).

Concluded from the above results, we can further confirm that the extension of the longevity does enhance economic growth. This positive relationship is supported by empirical evidence of both cross-sectional data and panel data analyzed, which is also true even when controlling the change of aged structure. Recall that extension of longevity has a positive impact on savings and now we have shown that there is a positive relationship between longevity and growth. Savings and growth are always positively related, which is also supported by substantial empirical evidence. Therefore, in this empirical study, it is very enlightening to have a further confirmation on our expectation that longevity affects economic growth positively by the following mechanism: longevity affects savings positively and then savings affect economic growth.

The similar mechanism used to explain the effect of the fraction of aged population on the economic growth can be partly supported by the panel data analysis but not from the cross-sectional data analysis. In cross-sectional data analysis, fractions of aged population perform unanimously (insignificantly) positive to growth. However, in panel data analysis, the relationship between the fraction of aged population and the economic growth change from positive to negative after controlling the regional dummy in full samples. Also, in non-poor country samples using the panel data, it is shown that aged female fraction is negatively related to growth while aged male fraction is positively related. Compared with cross-sectional data analysis, the change of sign in panel data may be due to the nature of the panel data itself, which reveals more hidden information by fully utilizing the data. Although we do not acquire the consistent results throughout the cross-sectional to panel data analysis, results from the panel data analysis still partly confirm our mechanism of explaining the impact of aged fractions on the economic growth. This thesis serves as a good starting point on this area and warrants further research on this aspect.

CHAPTER 6
CONCLUSION

This empirical research takes a fresh look at the impacts of population ageing on savings and economic growth. The main feature of my empirical analysis is that panel data given by World Bank Data 1995 are first employed to estimate the influence of ageing with the pooling technique. Meanwhile, results from estimating the cross-sectional data given by Barro (1989) are compared so that the robustness of the empirical findings can be judged and we can get more insight about the difference between panel and cross-sectional data.

A positive relationship between ageing and economic growth is obtained. As discussed before, the extension of longevity gives a positive impact on economic growth via affecting savings positively. This result is very robust and consistent throughout the results acquired from full and non-poor country samples with cross-sectional data as well as panel data. Besides, this positive linkage also confirms those obtained from numerous previous empirical studies.

The issue of the impacts of ageing on savings is very controversial in the literature. Different measures of ageing are used separately in most previous studies and hence their results do not come to a consensus. Those studies, which show ageing depresses savings and support life cycle hypothesis, use old-age dependency ratio as the measure of ageing. In contrast, those studies, which show ageing speeds up savings and supports our conventional wisdom, use life expectancy at birth instead. Since the interpretations of these two variables are different, and in fact they capture different things, they obviously each have its own, independent effects on savings. To my best knowledge, no such interpretation has been presented in the literature.

Moreover, in order to acquire a more reliable estimation result, both old-age dependency ratio and life expectancy at birth should enter into the model together in which the change of age structure and the longevity can be controlled at the same time. This point seems to be neglected in the previous literature. My empirical results strongly indicate that the fractions of aged population do depress savings. The empirical results are broadly consistent with the implications of life-cycle hypothesis that old people have a dissaving behavior.

On the contrary, a positive relationship between longevity and savings is only supported in the non-poor country samples (for both cross-sectional and panel data analyses), but not for full samples. In the case of non-poor country samples, countries involved belong to more developed countries in which the culture background, education system and government policy are more stable and similar. Therefore, the impacts of population ageing in non-poor countries can be captured easily in our estimation models.

In the case of full samples, however, less developed countries are involved in which there are so much heterogeneity across countries and some other factors that will affect the economic development as well as their savings behavior. Hence, it is very hard to use a relatively simple model to capture everything so as to estimate the impact of ageing on savings. Besides, the availability of data for poor countries is very insufficient, which causes the difficulties in our empirical estimation. These results could be a good guide to further research on the subject of the relationship between ageing and savings.

Other empirical findings conducted in this paper include the impacts of per capita GDP, human capital (enrollment ratios in primary and secondary school), quality of schooling, government consumption, political instability and growth rate of terms of trade. The findings for these variables are summarized as follows.

Per capita GDP is negatively related to economic growth, which supports the convergence hypothesis. It has also been shown that its effect is diminishing according to the quadratic term. However, the relationship between per capita GDP and savings is ambiguous among samples with panel data. The estimates are statistically insignificant. Similar inconsistent results with statistical insignificance can be found in the previous literature (see Barro (1991) and Barro and Sala-i-Martin (1995) for details).

There is a puzzling finding about the impact of enrollment ratios of primary and secondary school on savings and growth: Findings suggest that the former gives a positive effect, while the latter gives a negative effect in general. Actually, the signs of the estimated coefficients of these two variables fluctuate among the models. At this moment, no conclusion can be drawn for the influence of the human capital.

Qualities of schooling in primary and secondary level, which is measured by the student-teacher ratio, are shown to enhance savings and economic growth in non-poor countries. These results give an important message to the policy makers. Government should pay more attention on the quality of schooling. As it has been shown that better quality in schooling would enhance savings and speed up economic growth, it is worth investing more on improving the quality of schooling, such as lower the student-teacher ratio by increasing the number of qualified teachers.

The positive relationship with statistical significance between growth rate of terms of trade and savings is obtained. However, the signs of the estimated coefficients of the growth rate of terms of trade for estimating the economic growth are changing from positive to negative with respect to the samples from full to non-poor countries.

Finally, consistent adverse effects from government consumption and the political instability (number of revolutions and coups and the number of assassinations) on savings and growth have been shown among all regressions. These relations could involve the depressing effects of political instability on property rights and the linkage between property rights and private investment. All above results are preliminary but do suggest a payoff to further research on the interplay between population ageing, savings and economic growth.

TABLES

Table 1.1 Age Structure of the Population

	1950	1990	2025
World			
0-19	44.1	41.7	32.8
20-64	50.8	52.1	57.5
65+	5.1	6.2	9.7
OECD			
0-19	35.0	27.2	24.8
20-64	56.7	59.9	56.6
65+	8.3	12.8	18.6
US			
0-19	33.9	28.9	26.8
20-64	57.9	58.9	56.0
65+	8.1	12.2	17.2

Source: David N. Weil (1997)

Table 2.1 Hong Kong and Asia's Fertility Rate and Life Expectancy at Birth

			Hong Kong Life expectancy at birth (years)				Asia Life expectancy at birth (years)		
		Total fertility rate (per woman)	Males	Females	Both sexes combined	Total fertility rate (per woman)	Males	Females	Both sexes combined
Estimates	1950-1955	4.44	57.2	64.9	61	5.91	40.6	42	41.3
	1955-1960	4.72	61	68.5	64.8	5.63	44.1	45.5	44.8
	1960-1965	5.31	64	71.3	67.7	5.62	47.9	48.9	48.4
	1965-1970	4.02	66.5	73.5	70	5.69	53.2	54.2	53.7
	1970-1975	2.89	68.5	75.6	72	5.09	55.9	56.8	56.3
	1975-1980	2.32	70.5	76.8	73.6	4.22	57.7	59.3	58.5
	1980-1985	1.8	72.6	78.3	75.5	3.7	59.5	61.5	60.4
	1985-1990	1.31	74.3	79.9	76.2	3.39	61.4	63.7	62.5
	1990-1995	1.32	75.3	80.9	77.4	2.85	63.2	65.9	64.5
Medium-Variant Projections	1995-2000	1.32	75.8	81.4	78.5	2.6	64.8	67.9	66.3
	2000-2005	1.36	76.6	81.9	79.1	2.43	66.2	69.7	67.9
	2005-2010	1.43	76.8	82.4	79.3	2.28	67.6	71.3	69.4
	2010-2015	1.5	77.2	82.8	79.7	2.18	68.9	72.8	70.8
	2015-2020	1.57	77.6	83.1	80.1	2.14	70	74.2	72
	2020-2025	1.6	77.9	83.5	80.4	2.1	71.2	75.4	73.2
	2025-2030	1.6	78.4	83.9	80.9	2.07	72.1	76.5	74.2
	2030-2040	1.6	78.9	84.5	81.5	2.04	73.4	77.8	75.6
	2040-2050	1.6	79.7	85.3	82.3	2.03	74.7	79.2	76.9

Source: United Nations (1999)

Table 2.2 Hong Kong Population and Age Distribution

		Population (thousands)		Age distribution				
		Total	Percentage change of total pop.	Percentage aged 0-4	Percentage aged 5-14	Percentage aged 15-64	Percentage aged 65 or over	Percentage aged 65 or over (Asia)
Estimates	1950	1974	-	16	14.3	67.2	2.5	4.1
	1955	2490	26.1	16.4	19	62.2	2.5	4.1
	1960	3075	23.5	16	24.9	56.3	2.8	4.2
	1965	3692	20.1	14.3	26.2	68.3	3.2	4
	1970	3942	6.8	10.8	26.2	59.0	4	4
	1975	4396	11.5	9	21.4	64.2	5.4	4.2
	1980	5039	14.6	8.2	17.3	68.0	6.5	4.4
	1985	5456	8.3	7.7	15.7	69.1	7.4	4.6
	1990	5705	4.6	6.6	14.9	70.0	8.5	4.9
	1995	6224	9.1	5.9	13.7	70.8	9.7	5.4
Medium-Variant Projections	2000	6927	11.3	5.1	12.1	72.2	10.5	5.9
	2005	7321	5.7	4.7	10.8	73.2	11.2	6.4
	2010	7552	3.2	4.7	9.8	74.0	11.6	6.8
	2015	7689	1.8	4.7	9.4	72.2	13.7	7.6
	2020	7751	0.0081	4.6	9.4	69.1	17	8.8
	2025	7719	-0.00413	4.3	9.3	64.9	21.5	10.1
	2030	7621	-0.013	4	9	61.2	25.8	11.7
	2040	7233	-0.051	3.9	8.1	57.7	30.3	15.2
	2050	6664	-0.079	4	8.3	54.4	33.3	17.3

Source: United Nations (1999)

Table 4.1 The Correlation Coefficient between Ageing Variables and the Dependent Variables, without other variables being controlled. (no. of observations = 77)

	Panel Data			Cross-section Data		
Dependent Variable	INVGDP	SAVGDP	GRPCGDP	HSINV	SAV7085	GR7085
FEMALE	-0.329 (-7.46)	0.256 (5.685)	0.062 (1.336)	0.574 (6.077)	0.198 (1.746)	0.266 (2.393)
MALE	-0.375 (-8.666)	0.175 (3.818)	0.067 (1.44)	0.574 (6.067)	0.176 (1.546)	0.269 (2.414)
LTOT	-0.061 (-1.312)	0.395 (9.226)	0.201 (4.396)	0.678 (7.998)	0.268 (2.408)	0.395 (3.722)
LFEM	-0.045 (-0.9676)	0.421 (9.962)	0.191 (4.17)	0.682 (8.066)	0.274 (2.471)	0.382 (3.576)
LMAL	-0.065 (-1.394)	0.381 (8.852)	0.211 (4.63)	0.672 (7.862)	0.26 (2.33)	0.408 (3.865)

Notes. (i) For panel data, the observations of dependent variables are continuous from 1975 to 1980 and the observations of populations of aged above 65 and the life expectancy at birth are continuous from 1965 to 1970 and from 1967 to 1972 respectively.

(ii) For cross-section data, the observations of both dependent and independent variables are the average from 1970 to 1985.

(iii) T-value of coefficient estimates appear in parentheses.

Table 5.1 Regressions for Saving of Cross-sectional Data (Dependent Variable = INV7085; number of observations = 91)

	(C1)	(C2)	(C3)	(C4)	(C5)	(C6)
Constant	0.0741	0.0754	0.0759	-0.5617	-0.5797	-0.5172
	(0.048)	(0.039)	(0.040)	(0.049)	(0.041)	(0.065)
Per capita GDP at 1970	0.0316	0.0317	0.0314	0.0258	0.0247	0.0276
	(0.028)	(0.027)	(0.028)	(0.076)	(0.091)	(0.056)
Square of Per capita GDP at 1970	-0.0029	-0.0029	-0.0029	-0.0025	-0.0025	-0.0027
	(0.042)	(0.039)	(0.038)	(0.079)	(0.088)	(0.064)
Primary school enrollment rate at 1970	0.0581	0.0573	0.0570			
	(0.083)	(0.083)	(0.086)			
Secondary school enrollment rate at 1970	0.0753	0.0776	0.0759	0.0274	0.0264	0.0309
	(0.163)	(0.140)	(0.157)	(0.591)	(0.602)	(0.545)
Average government consumption ratio, 1970-85	0.0927	0.0957	0.0974	0.1152	0.1161	0.1130
	(0.379)	(0.355)	(0.348)	(0.250)	(0.245)	(0.260)
Number of revolutions and coups, 1970-85	-0.0349	-0.0352	-0.0354			
	(0.300)	(0.293)	(0.290)			
Number of assassinations, 1970-85	-0.0219	-0.0217	-0.0216	-0.0299	-0.0303	-0.0295
	(0.145)	(0.145)	(0.148)	(0.028)	(0.026)	(0.031)
Average female fraction aged 65 or above, 1970-85	-0.0028	-0.0013				
	(0.732)	(0.649)				
Average male fraction aged 65 or above, 1970-85	0.0023		-0.0014			
	(0.845)		(0.720)			
Log (Average total life expectancy), 1970-85				0.1709		
				(0.021)		
Log (Average female life expectancy), 1970-85					0.1744	
					(0.017)	
Log (Average male life expectancy), 1970-85						0.1603
						(0.029)
Adjusted R^2	0.4336	0.4402	0.4397	0.4552	0.4575	0.4517
Estimate σ	0.0592	0.0589	0.0589	0.0581	0.0580	0.0583

Notes. The dependent variable HSINV which is used for proxy saving rate from 1970 to 1985. P-value of coefficient estimates appear in parentheses. See Appendix 2 for definitions of variables. All variables come from Barro's data except the proxies of ageing variables (FEM7085, MALE7085, LLTOT, LLFEM and LLMAL) which come from World Bank's data.

Table 5.1 (Continued) *Regressions for Saving of Cross-sectional Data (Dependent Variable = INV7085; number of observations = 91)*

	(C7)	(C8)	(C9)	(C10)	(C11)
Constant	0.0777	0.0801	-0.8441	-0.8397	-0.8104
	(0.041)	(0.037)	(0.008)	(0.007)	(0.012)
Per capita GDP at 1970	0.0403	0.0394	0.0296	0.0288	0.0311
	(0.009)	(0.010)	(0.041)	(0.047)	(0.031)
Square of Per capita GDP at 1970	-0.0037	-0.0037	-0.0031	-0.0030	-0.0032
	(0.015)	(0.016)	(0.035)	(0.036)	(0.030)
Primary school enrollment rate at 1970	0.0614	0.0605			
	(0.064)	(0.069)			
Secondary school enrollment rate at 1970	0.0703	0.0675	0.0013	-0.0029	0.0082
	(0.219)	(0.240)	(0.981)	(0.956)	(0.876)
Average government consumption ratio, 1970-85	0.0963	0.1021	0.0978	0.1006	0.0942
	(0.355)	(0.329)	(0.319)	(0.305)	(0.340)
Number of revolutions and coups, 1970-85	-0.0244	-0.0253			
	(0.470)	(0.455)			
Number of assassinations, 1970-85	-0.0200	-0.0199	-0.0234	-0.0242	-0.0228
	(0.180)	(0.183)	(0.083)	(0.072)	(0.093)
Average female fraction aged 65 or above, 1970-85	-0.0028				
	(0.339)				
Average male fraction aged 65 or above, 1970-85		-0.0035			
		(0.407)			
Log (Average total life expectancy), 1970-85			0.2421		
			(0.003)		
Log (Average female life expectancy), 1970-85				0.2402	
				(0.002)	
Log (Average male life expectancy), 1970-85					0.2342
					(0.005)
Sub-Saharan Africa	-0.0049	-0.0066	0.0215	0.0168	0.0251
	(0.811)	(0.748)	(0.316)	(0.418)	(0.259)
Latin America	-0.0303	-0.0298	-0.0295	-0.0324	-0.0266
	(0.101)	(0.108)	(0.083)	(0.059)	(0.119)
Adjusted R^2	0.4465	0.4449	0.4806	0.4833	0.4757
Estimate σ	0.0586	0.0586	0.0567	0.0566	0.0570

Notes. The dependent variable HSINV which is used for proxy saving rate from 1970 to 1985. P-value of coefficient estimates appear in parentheses. See Appendix 2 for definitions of variables. All variables come from Barro's data except the proxies of ageing variables (FEM7085, MALE7085, LLTOT, LLFEM and LLMAL) which come from World Bank's data.

Table 5.2 *Regressions for Per Capita Growth of Cross-sectional Data (Dependent Variable = GR7085; number of observations = 91)*

	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)	(C20)	(C21)
Constant	0.0169	0.0176	0.0165	-0.1663	-0.1518	-0.1719	0.0314	-0.1379	-0.1448	-0.1223
	(0.119)	(0.099)	(0.124)	(0.058)	(0.085)	(0.045)	(0.003)	(0.142)	(0.111)	(0.197)
Per capita GDP at 1970	-0.0142	-0.0141	-0.0014	-0.0159	-0.1576	-0.0159	-0.0130	-0.0127	-0.0129	-0.0124
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)	(0.002)
Square of Per capita GDP at 1970	0.0008	0.0008	0.0008	0.0010	0.0010	0.0010	0.0007	0.0007	0.0007	0.0007
	(0.067)	(0.068)	(0.063)	(0.019)	(0.022)	(0.017)	(0.089)	(0.073)	(0.070)	(0.080)
Primary school enrollment rate at 1970	0.0109	0.0105	0.0113	0.0035	0.0034	0.0039	0.0157	0.0099	0.0092	0.0109
	(0.258)	(0.271)	(0.239)	(0.726)	(0.736)	(0.688)	(0.074)	(0.284)	(0.319)	(0.239)
Secondary school enrollment rate at 1970	0.0215	0.0226	0.0214	0.0223	0.0237	0.0216	-0.0010	-0.0002	-0.0013	0.0013
	(0.167)	(0.135)	(0.167)	(0.130)	(0.109)	(0.141)	(0.945)	(0.989)	(0.925)	(0.924)
Average government consumption ratio, 1970-85	-0.1320	-0.1304	-0.1332	-0.1211	-0.1223	-0.1202	-0.1103	-0.1092	-0.1090	-0.1096
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of revolutions and coups, 1970-85	-0.0271	-0.0272	-0.0270	-0.0250	-0.0259	-0.0241	-0.0237	-0.0201	-0.0206	-0.0197
	(0.006)	(0.005)	(0.006)	(0.010)	(0.008)	(0.014)	(0.008)	(0.024)	(0.019)	(0.029)
Number of assassinations, 1970-85	-0.0004	-0.0003	-0.0005	-0.0014	-0.0013	-0.0014	-0.0014	-0.0018	-0.0019	-0.0017
	(0.921)	(0.940)	(0.901)	(0.746)	(0.758)	(0.745)	(0.714)	(0.642)	(0.626)	(0.662)
Average investment ratio, 1970-85	0.1417	0.1420	0.1413	0.1267	0.1270	0.1269	0.1277	0.1092	0.1077	0.1113
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Average female fraction aged 65 or above, 1970-80	0.0008	0.0015					0.0022			
	(0.744)	(0.060)					(0.309)			
Average male fraction aged 65 or above, 1970-80	0.0012		0.0022				-0.0014			
	(0.721)		(0.060)				(0.638)			
Log (Average total life expectancy), 1970-85				0.0495				0.0444		
				(0.033)				(0.070)		
Log (Average female life expectancy), 1970-85					0.0455				0.0462	
					(0.050)				(0.052)	
Log (Average male life expectancy), 1970-85						0.0511				0.0403
						(0.025)				(0.103)
Sub-Saharan Africa							-0.0226	-0.0165	-0.0172	-0.0163
							(0.000)	(0.006)	(0.003)	(0.009)
Latin America							-0.0171	-0.0202	-0.0208	-0.0197
							(0.001)	(0.000)	(0.000)	(0.000)
Adjusted R^2	0.4552	0.4611	0.4612	0.4677	0.4631	0.4711	0.5631	0.5712	0.5739	0.5677
Estimate σ	0.0169	0.0168	0.0168	0.0167	0.0167	0.0166	0.0151	0.0150	0.0149	0.0150

Notes. The dependent variable HSINV which is used for proxy saving rate from 1970 to 1985. P-value of coefficient estimates appear in parentheses. See Appendix 5 for definitions of variables. All variables come from Barro's data except the proxies of ageing variables (FEM7085, MALE7085, LTOT7085, LFEM7085, LMAL7085, LLTOT, LLFEM and LLMAL) and SAVGDP which come from World Bank's data.

Table 5.3 Regressions of Cross-sectional Data for Non-poor Countries (Number of observations = 44)

	(C22)	(C23)	(C24)	(C25)	(C26)	(C27)	(C28)	(C29)	(C30)	(C31)	(C32)
Dept. Variable	HSINV	HSINV	HSINV	HSINV	HSINV	HSINV	GR7085	GR7085	GR7085	GR7085	GR7085
Constant	0.0911	0.1146	0.1236	-1.0722	-0.8509	-1.1602	0.0578	0.0546	-0.0017	0.0499	-0.0480
	(0.285)	(0.168)	(0.130)	(0.199)	(0.320)	(0.137)	(0.039)	(0.054)	(0.994)	(0.816)	(0.820)
Per capita GDP at 1970	0.0143	0.0159	0.0140	0.0058	0.0086	0.0043	-0.0163	-0.0162	-0.0146	-0.0140	-0.0151
	(0.499)	(0.452)	(0.510)	(0.785)	(0.687)	(0.838)	(0.004)	(0.004)	(0.013)	(0.017)	(0.010)
Square of Per capita GDP at 1970	-0.0016	-0.0018	-0.0017	-0.0012	-0.0015	-0.0011	0.0011	0.0011	0.0010	0.0009	0.0010
	(0.439)	(0.357)	(0.390)	(0.537)	(0.455)	(0.592)	(0.041)	(0.041)	(0.076)	(0.087)	(0.066)
Primary school enrollment rate at 1970	0.1272	0.1007	0.0944				0.0072	0.0105	0.0109	0.0120	0.0104
	(0.131)	(0.210)	(0.234)				(0.719)	(0.596)	(0.604)	(0.572)	(0.615)
Secondary school enrollment rate at 1970	0.0906	0.1061	0.0887	0.0434	0.0507	0.0426					
	(0.248)	(0.172)	(0.261)	(0.517)	(0.463)	(0.508)					
Student-teacher ratio in primary school at 1970							-0.0009	-0.0009	-0.0011	-0.0011	-0.0010
							(0.021)	(0.027)	(0.006)	(0.005)	(0.008)
Average government consumption ratio, 1970-85	-0.2241	-0.1835	-0.1820	-0.1480	-0.1481	-0.1514	-0.0915	-0.0957	-0.0974	-0.0986	-0.0970
	(0.126)	(0.193)	(0.199)	(0.273)	(0.279)	(0.257)	(0.014)	(0.010)	(0.011)	(0.011)	(0.011)
Number of revolutions and coups, 1970-85	0.0071	0.0109	0.0091				-0.0323	-0.0323	-0.0326	-0.0338	-0.0311
	(0.917)	(0.873)	(0.894)				(0.020)	(0.020)	(0.031)	(0.024)	(0.041)
Number of assassinations, 1970-85	-0.0319	-0.0332	-0.0340	-0.0283	-0.0311	-0.0261					
	(0.138)	(0.123)	(0.115)	(0.102)	(0.072)	(0.132)					
Average investment ratio, 1970-85							0.1475	0.1443	0.1437	0.1469	0.1398
							(0.001)	(0.001)	(0.002)	(0.001)	(0.003)
Average female fraction aged 65 or above, 1970-85	-0.0121	-0.0016					0.0011				
	(0.240)	(0.644)					(0.166)				
Average male fraction aged 65 or above, 1970-85	0.0155		-0.0003					0.0014			
	(0.278)		(0.945)					(0.185)			
Log (Average total life expectancy), 1970-85				0.3141					0.0159		
				(0.129)					(0.766)		
Log (Average female life expectancy), 1970-85					0.2573					0.0031	
					(0.220)					(0.953)	
Log (Average male life expectancy), 1970-85						0.3387					0.0275
						(0.082)					(0.597)
Adjusted R^2	0.2251	0.2204	0.2156	0.2738	0.2576	0.2878	0.5459	0.5438	0.5212	0.5200	0.5238
Estimate σ	0.0585	0.0587	0.0588	0.0567	0.0572	0.0561	0.0147	0.0147	0.0151	0.0151	0.0150

Notes. P-value of coefficient estimates appear in parentheses. See Appendix 2 for definitions of variables. All variables come from Barro's data except the proxies of ageing variables (FEM7085, MALE7085, TOT7085, LFEM7085, LMAL7085, LLTOT, LLFEM and LLMAL) and SAVGDP which come from World Bank's data.

Table 5.4 Results for Savings Rate with panel data for 77 countries from 1975-80 (number of observations = 462)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent Variable	SAVGDP	SAVGDP	SAVGDP	SAVGDP	SAVGDP	SAVGDP	SAVGDP	INVGDP	INVGDP	INVGDP	INVGDP	INVGDP
Constant	-0.2448	-0.2135	-0.2086	0.1144	-0.0087	0.1137	0.0529	0.0925	0.1059	0.4751	0.4661	0.4416
	(0.000)	(0.000)	(0.000)	(0.397)	(0.952)	(0.408)	(0.721)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Log (Per capita GDP)	0.0450	0.0446	0.0436	0.0278	0.0273	0.0274	0.0265	0.0172	0.0154	0.0126	0.0086	0.0108
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.023)	(0.000)
Primary school enrollment ratio	0.0019	0.0018	0.0018	0.0023	0.0023	0.0023	0.0022	0.0012	0.0012	0.0016	0.0016	0.0016
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Secondary school enrollment ratio	-0.0002	0.0001	0.0001	-0.0004	-0.0005	-0.0004	-0.0004	-0.0007	-0.0006	-0.0006	-0.0005	-0.0007
	(0.136)	(0.628)	(0.577)	(0.032)	(0.008)	(0.043)	(0.035)	(0.000)	(0.001)	(0.001)	(0.010)	(0.000)
Government consumption ratio	-0.0028	-0.0038	-0.0042	-0.0138	-0.0123	-0.0139	-0.0134	-0.0371	-0.0385	-0.0375	-0.0385	-0.0392
	(0.531)	(0.320)	(0.282)	(0.005)	(0.013)	(0.004)	(0.009)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Growth rate of terms of trade	0.0736	0.0744	0.0744	0.0777	0.0769	0.0772	0.0771	-0.0064	-0.0052	-0.0047	-0.0045	-0.0043
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.182)	(0.295)	(0.393)	(0.420)	(0.426)
Female fraction aged 65 or above, 1965-70	-0.0104		0.0007					-0.0063				
	(0.000)		(0.799)					(0.000)				
Male fraction aged 65 or above, 1965-70		-0.0181	-0.0188						-0.0089			
		(0.000)	(0.000)						(0.000)			
Log (Total life expectancy), 1967-72				-0.0784						-0.1053		
				(0.032)						(0.006)		
Log (Female life expectancy), 1967-72					-0.0450		0.0731				-0.0966	
					(0.254)		(0.341)				(0.018)	
Log (Male life expectancy), 1967-72						-0.0774	-0.1320					-0.0939
						(0.034)	(0.064)					(0.006)
Buse Raw-moment R^2	0.9570	0.9590	0.9570	0.9493	0.9482	0.9463	0.9465	0.9822	0.9823	0.9621	0.9614	0.9688
Estimate σ	0.9685	0.9669	0.9681	0.9584	0.9597	0.9559	0.9557	0.9922	0.9956	0.9757	0.9784	0.9772

Table 5.4 (Continued) Results for Savings Rate with panel data for 77 countries from 1975-80 (number of observations = 462)

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
Dependent Variable	SAVGDP	SAVGDP	SAVGDP	SAVGDP	SAVGDP	INVGDP	INVGDP	INVGDP	INVGDP	INVGDP
Constant	-0.2572	-0.1996	0.3522	0.2129	0.3269	0.0705	0.0874	0.4777	0.3853	0.4651
	(0.000)	(0.000)	(0.003)	(0.117)	(0.008)	(0.000)	(0.000)	(0.008)	(0.025)	(0.007)
Log (Per capita GDP)	0.0493	0.0457	0.0296	0.0279	0.0288	0.0170	0.0160	0.0120	0.0069	0.0108
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.011)	(0.129)	(0.009)
Primary school enrollment ratio	0.0020	0.0017	0.0025	0.0024	0.0024	0.0013	0.0013	0.0016	0.0016	0.0016
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Secondary school enrollment ratio	-0.0004	-0.0001	-0.0004	-0.0004	-0.0004	-0.0004	-0.0003	-0.0006	-0.0005	-0.0006
	(0.030)	(0.586)	(0.061)	(0.050)	(0.069)	(0.011)	(0.097)	(0.004)	(0.027)	(0.002)
Government consumption ratio	-0.0053	-0.0063	-0.0187	-0.0163	-0.0183	-0.0343	-0.0366	-0.0374	-0.0372	-0.0390
	(0.245)	(0.105)	(0.001)	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Growth rate of terms of trade	0.0728	0.0742	0.0775	0.0761	0.0772	-0.0086	-0.0084	-0.0068	-0.0076	-0.0066
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.114)	(0.128)	(0.231)	(0.187)	(0.242)
Female fraction aged 65 or above, 1965-70	-0.0119					-0.0072				
	(0.000)					(0.000)				
Male fraction aged 65 or above, 1965-70		-0.0179					-0.0108			
		(0.000)					(0.000)			
Log (Total life expectancy), 1967-72			-0.1422					-0.1053		
			(0.000)					(0.044)		
Log (Female life expectancy), 1967-72				-0.1020					-0.0745	
				(0.006)					(0.130)	
Log (Male life expectancy), 1967-72					-0.1340					-0.1001
					(0.000)					(0.041)
Sub-Saharan Africa	-0.0211	-0.0235	-0.0256	-0.0216	-0.0266	0.0178	0.0127	0.0007	0.0113	-0.0012
	(0.032)	(0.006)	(0.000)	(0.013)	(0.001)	(0.092)	(0.235)	(0.958)	(0.373)	(0.935)
Latin America	-0.0206	-0.0183	-0.0062	-0.0029	-0.0067	-0.0045	-0.0068	0.0050	0.0058	0.0043
	(0.023)	(0.040)	(0.430)	(0.727)	(0.410)	(0.461)	(0.230)	(0.036)	(0.372)	(0.487)
Buse Raw-moment R^2	0.9574	0.9497	0.9596	0.9483	0.9555	0.9748	0.9822	0.9638	0.9652	0.9683
Estimate σ	0.9693	0.9654	0.9622	0.9608	0.9583	0.9928	0.9933	0.9776	0.9805	0.9789

Table 5.5 Results for Savings Rate with panel data for 39 Non-poor Countries from 1975-80 (number of observations = 234)

	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)
Dependent Variable	SAVGDP	SAVGDP	SAVGDP	SAVGDP	SAVGDP	SAVGDP	SAVGDP	SAVGDP	SAVGDP	SAVGDP
Constant	-0.2056	-0.0871	-0.0667	-0.0111	2.8023	2.3082	2.7283	2.7303	2.2276	2.5893
	(0.000)	(0.096)	(0.349)	(0.873)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log (Per capita GDP)	0.0696	0.0600	0.0523	0.0500	0.0563	0.0502	0.0514	0.0545	0.0487	0.0502
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Primary school enrollment ratio	0.0012	0.0006	-0.0000	-0.0004	0.0008	0.0007	0.0010	0.0007	0.0004	0.0007
	(0.000)	(0.055)	(0.950)	(0.367)	(0.023)	(0.050)	(0.007)	(0.066)	(0.307)	(0.062)
Secondary school enrollment ratio	-0.0024	-0.0021	-0.0012	-0.0011	-0.0002	-0.0005	-0.0002	0.0000	0.0000	0.0000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.397)	(0.033)	(0.291)	(0.843)	(0.961)	(0.806)
Government consumption ratio	-0.3656	-0.3471	-0.4012	-0.4106	-0.3254	-0.3181	-0.2625	-0.3394	-0.3762	-0.3169
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Growth rate of terms of trade	0.0986	0.0995	0.1011	0.0992	0.0969	0.0957	0.1013	0.1025	0.1008	0.1046
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female fraction aged 65 or above, 1965-70	-0.0065		-0.0062							
	(0.000)		(0.000)							
Male fraction aged 65 or above, 1965-70		-0.0085		-0.0086						
		(0.000)		(0.000)						
Log (Total life expectancy), 1967-72					-0.7279			-0.7142		
					(0.000)			(0.000)		
Log (Female life expectancy), 1967-72						-0.5851			-0.5755	
						(0.000)			(0.000)	
Log (Male life expectancy), 1967-72							-0.7116			-0.6805
							(0.000)			(0.000)
Student-teacher ratio in primary school			0.0036	0.0036				0.0017	0.0030	0.0018
			(0.000)	(0.000)				(0.000)	(0.000)	(0.000)
Student-teacher ratio in secondary school			-0.0015	-0.0017				-0.0004	-0.0007	-0.0003
			(0.003)	(0.001)				(0.217)	(0.081)	(0.423)
Buse Raw-moment R^2	0.9864	0.9769	0.9780	0.9781	0.9815	0.9800	0.9872	0.9915	0.9811	0.9911
Estimate σ	0.9864	0.9862	0.9731	0.9732	0.9709	0.9664	0.9676	0.9855	0.9881	0.9821

Table 5.5 (Continued) Results for Savings Rate with panel data for 39 Non-poor Countries from 1975-80 (number of observations = 234)

	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)
Dependent Variable	INVGDP	INVGDP	INVGDP	INVGDP	INVGDP	INVGDP	INVGDP	INVGDP	INVGDP	INVGDP
Constant	0.2036	0.2262	0.1546	0.2292	1.6334	1.0385	1.6142	1.5072	1.1317	1.3202
	(0.001)	(0.000)	(0.016)	(0.000)	(0.000)	(0.003)	(0.335)	(0.000)	(0.001)	(0.000)
Log (Per capita GDP)	0.0201	0.0183	0.0238	0.0165	0.0243	0.012759	0.0229	0.0179	0.0091	0.0143
	(0.004)	(0.005)	(0.000)	(0.013)	(0.001)	(0.082)	(0.000)	(0.009)	(0.184)	(0.024)
Primary school enrollment ratio	0.0001	0.0001	0.0002	0.0001	0.0011	0.00049752	0.0008	0.0005	0.0003	0.0005
	(0.679)	(0.745)	(0.525)	(0.660)	(0.000)	(0.164)	(0.003)	(0.093)	(0.426)	(0.134)
Secondary school enrollment ratio	-0.0013	-0.0016	-0.0009	-0.0009	-0.0006	-0.00081065	-0.0006	-0.0005	-0.0005	-0.0005
	(0.000)	(0.000)	(0.001)	(0.001)	(0.007)	(0.003)	(0.005)	(0.055)	(0.074)	(0.024)
Government consumption ratio	-0.1405	-0.1464	-0.1655	-0.1405	-0.1799	-0.15314	-0.1866	-0.1348	-0.1104	-0.1290
	(0.001)	(0.001)	(0.001)	(0.004)	(0.000)	(0.001)	(0.000)	(0.012)	(0.030)	(0.018)
Growth rate of terms of trade	0.0281	0.0290	0.0265	0.0273	0.0201	0.015666	0.2450	0.0257	0.0217	0.0278
	(0.042)	(0.039)	(0.075)	(0.068)	(0.150)	(0.265)	(0.081)	(0.081)	(0.144)	(0.061)
Female fraction aged 65 or above, 1965-70	-0.0030		-0.0053							
	(0.007)		(0.000)							
Male fraction aged 65 or above, 1965-70		-0.0018		-0.0068						
		(0.244)		(0.000)						
Log (Total life expectancy), 1967-72					-0.3844			-0.3305		
					(0.001)			(0.000)		
Log (Female life expectancy), 1967-72						-0.20366			-0.2179	
						(0.027)			(0.012)	
Log (Male life expectancy), 1967-72							-0.3748			-0.2793
							(0.000)			(0.001)
Student-teacher ratio in primary school			0.0014	0.0011				0.0007	0.0010	0.0007
			(0.018)	(0.074)				(0.234)	(0.080)	(0.224)
Student-teacher ratio in secondary school			-0.0015	-0.0016				-0.0013	-0.0015	-0.0013
			(0.002)	(0.001)				(0.003)	(0.001)	(0.007)
Buse Raw-moment R^2	0.9797	0.9865	0.9773	0.9748	0.9889	0.9836	0.9889	0.9847	0.9735	0.9846
Estimate σ	0.9804	0.9860	0.9719	0.9677	0.9894	0.9776	0.9892	0.9910	0.9814	0.9887

Table 5.6 Results for Growth Rate of Real Per Capita GDP with panel data for 77 countries from 1975 to 1980 (dependent variable = GRPCGDP; number of observations = 462)

	(43)	(44)	(45)	(46)	(47)	(48)	(49)	(50)	(51)	(52)
Constant	0.0372	0.0374	0.0321	0.0323	-0.3416	-0.3101	-0.3217	0.0098	0.0094	0.0013
	(0.007)	(0.005)	(0.021)	(0.016)	(0.000)	(0.000)	(0.000)	(0.479)	(0.485)	(0.926)
Log (Per capita GDP)	-0.0061	-0.0064	-0.0056	-0.0058	-0.0072	-0.0060	-0.0060	-0.0051	-0.0053	-0.0044
	(0.007)	(0.004)	(0.015)	(0.010)	(0.001)	(0.002)	(0.003)	(0.022)	(0.014)	(0.050)
Primary school enrollment ratio	0.0000	0.0000	0.0000	0.0000	-0.0002	-0.0002	-0.0002	0.0001	0.0001	0.0001
	(0.943)	(0.864)	(0.891)	(0.830)	(0.025)	(0.064)	(0.038)	(0.263)	(0.214)	(0.209)
Secondary school enrollment ratio	0.0003	0.0003	0.0003	0.0003	-0.0002	-0.0002	-0.0002	0.0003	0.0003	0.0003
	(0.008)	(0.016)	(0.011)	(0.018)	(0.209)	(0.173)	(0.212)	(0.002)	(0.004)	(0.003)
Government consumption ratio	-0.0027	-0.0031						-0.0008	-0.0012	
	(0.521)	(0.466)						(0.858)	(0.785)	
Government consumption ratio, 1969-74			0.0053	0.0052	0.0059	0.0059	0.0061			0.0082
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)			(0.000)
Saving ratio	0.0726	0.0742	0.0745	0.0759	0.0701	0.0686	0.0677			
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)			
Investment ratio								0.0885	0.0893	0.0948
								(0.000)	(0.000)	(0.000)
Growth rate of terms of trade	0.0173	0.0169	0.0188	0.0186	0.0182	0.0191	0.0184	0.0259	0.0257	0.0264
	(0.034)	(0.038)	(0.019)	(0.021)	(0.020)	(0.014)	(0.020)	(0.002)	(0.002)	(0.001)
Female fraction aged 65 or above, 1965-70	0.0003		0.0002					0.0003		0.0002
	(0.446)		(0.601)					(0.416)		(0.563)
Male fraction aged 65 or above, 1965-70		0.0008		0.0005					0.0008	
		(0.257)		(0.412)					(0.245)	
Log (Total life expectancy), 1967-72					0.1057					
					(0.000)					
Log (Female life expectancy), 1967-72						0.0947				
						(0.000)				
Log (Male life expectancy), 1967-72							0.0991			
							(0.000)			
Buse Raw-moment R^2	0.5155	0.5157	0.5801	0.5807	0.6264	0.6489	0.5990	0.5371	0.5392	0.5977
Estimate σ	0.9976	0.9972	0.9961	0.9957	0.9959	0.9967	0.9958	0.9995	0.9994	0.9977

Table 5.6 (Continued) Results for Growth Rate of Real Per Capita GDP with panel data for 77 countries from 1975 to 1980 (dependent variable = GRPCGDP; number of observations = 462)

	(53)	(54)	(55)	(56)	(57)	(58)	(59)	(60)	(61)	(62)
Constant	0.0008	-0.4244	-0.4110	-0.4022	-0.2173	-0.2133	-0.1830	-0.2577	-0.2664	-0.2372
	(0.950)	(0.000)	(0.000)	(0.000)	(0.007)	(0.004)	(0.020)	(0.001)	(0.000)	(0.002)
Log (Per capita GDP)	-0.0045	-0.0069	-0.0061	-0.0056	-0.0056	-0.0038	-0.0046	-0.0035	-0.0031	-0.0025
	(0.038)	(0.001)	(0.001)	(0.005)	(0.017)	(0.071)	(0.037)	(0.135)	(0.157)	(0.253)
Primary school enrollment ratio	0.0001	-0.0002	-0.0002	-0.0002	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0000
	(0.176)	(0.008)	(0.023)	(0.015)	(0.274)	(0.355)	(0.369)	(0.494)	(0.301)	(0.650)
Secondary school enrollment ratio	0.0003	-0.0002	-0.0002	-0.0002	-0.0003	-0.0004	-0.0003	-0.0003	-0.0004	-0.0003
	(0.004)	(0.185)	(0.101)	(0.172)	(0.019)	(0.002)	(0.026)	(0.012)	(0.004)	(0.012)
Government consumption ratio					-0.0063	-0.0047	-0.0079			
					(0.131)	(0.209)	(0.082)			
Government consumption ratio, 1969-74	0.0081	0.0085	0.0084	0.0087						
	(0.000)	(0.000)	(0.000)	(0.000)						
Log (Government consumption)								-0.0077	-0.0068	-0.0082
								(0.001)	(0.004)	(0.001)
Saving ratio					0.0680	0.0632	0.0670			
					(0.000)	(0.000)	(0.000)			
Investment ratio	0.0952	0.1022	0.1026	0.0992				0.0926	0.0942	0.0916
	(0.000)	(0.000)	(0.000)	(0.000)				(0.000)	(0.000)	(0.000)
Growth rate of terms of trade	0.0262	0.0256	0.0265	0.0259	0.0170	0.0191	0.0170	0.0282	0.0299	0.0279
	(0.001)	(0.001)	(0.001)	(0.001)	(0.034)	(0.018)	(0.034)	(0.000)	(0.000)	(0.000)
Male fraction aged 65 or above, 1965-70	0.0005									
	(0.409)									
Log (Total life expectancy), 1967-72		0.1230			0.0743			0.0736		
		(0.000)			(0.001)			(0.001)		
Log (Female life expectancy), 1967-72			0.1171			0.0706			0.0759	
			(0.000)			(0.001)			(0.000)	
Log (Male life expectancy), 1967-72				0.1157			0.0640			0.0665
				(0.000)			(0.004)			(0.002)
Sub-Saharan Africa					-0.0208	-0.0239	-0.0212	-0.0253	-0.0265	-0.0254
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Latin America					-0.1670	-0.0176	-0.0164	-0.0198	-0.0194	-0.0197
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Buse Raw-moment R^2	0.5980	0.6313	0.6647	0.6037	0.5677	0.5676	0.5678	0.5990	0.6009	0.5999
Estimate σ	0.9974	0.9972	0.9977	0.9971	0.9997	1.0000	0.9998	1.0037	1.0038	1.0033

Table 5.7 Results for Growth Rate of Real Per Capita GDP with panel data for 39 Non-poor Countries from 1975 to 1980 (dependent variable = GRPCGDP; number of observations = 234)

	(63)	(64)	(65)	(66)	(67)	(68)
Constant	-0.5440	-0.2211	-0.5665	-0.3543	-0.0242	-0.3666
	(0.000)	(0.175)	(0.000)	(0.040)	(0.895)	(0.025)
Log (Per capita GDP)	-0.0117	-0.0118	-0.0096	-0.0164	-0.0187	-0.0148
	(0.002)	(0.001)	(0.016)	(0.000)	(0.000)	(0.001)
Primary school enrollment ratio	-0.0006	-0.0005	-0.0006	-0.0005	-0.0005	-0.0005
	(0.030)	(0.100)	(0.048)	(0.075)	(0.133)	(0.087)
Secondary school enrollment ratio	-0.0001	0.0001	-0.0002	-0.0001	0.0002	-0.0001
	(0.564)	(0.669)	(0.468)	(0.753)	(0.407)	(0.683)
Government consumption ratio, 1969-74	0.1055	0.0969	0.1032	0.0920	0.0951	0.0884
	(0.001)	(0.003)	(0.001)	(0.004)	(0.005)	(0.007)
Saving ratio	0.1669	0.1182	0.1678	0.1443	0.1139	0.1435
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Growth rate of terms of trade	-0.0420	-0.0352	-0.0443	-0.0439	-0.0412	-0.0451
	(0.011)	(0.035)	(0.006)	(0.005)	(0.011)	(0.004)
Log (Total life expectancy), 1967-72	0.1628			0.1300		
	(0.000)			(0.001)		
Log (Female life expectancy), 1967-72		0.0822			0.0530	
		(0.035)			(0.205)	
Log (Male life expectancy), 1967-72			0.1643			0.1306
			(0.000)			(0.001)
Student-teacher ratio in primary school				-0.0000	-0.0002	-0.0000
				(0.911)	(0.535)	(0.879)
Student-teacher ratio in secondary school				-0.0009	-0.0009	-0.0009
				(0.007)	(0.006)	(0.009)
Buse Raw-moment R^2	0.6699	0.6042	0.6902	0.7447	0.6891	0.7750
Estimate σ	1.0104	1.0048	1.0107	1.0066	1.0010	1.0073

Table 5.7 (Continued) Results for Growth Rate of Real Per Capita GDP with panel data for 39 Non-poor Countries from 1975 to 1980 (dependent variable = GRPCGDP; number of observations = 234)

	(69)	(70)	(71)	(72)	(73)	(74)
Constant	-0.3840	-0.2106	-0.3413	-0.2088	0.0091	-0.1755
	(0.017)	(0.221)	(0.029)	(0.252)	(0.962)	(0.301)
Log (Per capita GDP)	-0.0060	-0.0070	-0.0050	-0.0111	-0.0132	-0.0105
	(0.176)	(0.109)	(0.276)	(0.015)	(0.003)	(0.025)
Primary school enrollment ratio	-0.0004	-0.0003	-0.0003	-0.0005	-0.0004	-0.0004
	(0.256)	(0.381)	(0.367)	(0.136)	(0.199)	(0.158)
Secondary school enrollment ratio	-0.0001	0.0001	-0.0001	-0.0000	0.0002	0.0000
	(0.547)	(0.741)	(0.667)	(0.980)	(0.404)	(0.936)
Government consumption ratio, 1969-74	0.0605	0.0678	0.0608	0.0568	0.0655	0.0567
	(0.054)	(0.035)	(0.056)	(0.093)	(0.059)	(0.098)
Investment ratio	0.1284	0.1249	0.1229	0.1108	0.1021	0.1060
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Growth rate of terms of trade	-0.0284	-0.0258	-0.0287	-0.0287	-0.0284	-0.0292
	(0.057)	(0.091)	(0.055)	(0.050)	(0.058)	(0.046)
Log (Total life expectancy), 1967-72	0.1096			0.0837		
	(0.008)			(0.053)		
Log (Female life expectancy), 1967-72		0.0648			0.0327	
		(0.133)			(0.465)	
Log (Male life expectancy), 1967-72			0.0961			0.0748
			(0.013)			(0.059)
Student-teacher ratio in primary school				0.0002	0.0000	0.0001
				(0.630)	(0.982)	(0.683)
Student-teacher ratio in secondary school				-0.0010	-0.0010	-0.0009
				(0.004)	(0.004)	(0.004)
Buse Raw-moment R^2	0.6097	0.6171	0.6062	0.6374	0.6545	0.6349
Estimate σ	1.0053	1.0063	1.0048	1.0043	1.0034	1.0034

Table 5.8 Signs of Estimated Coefficients of Ageing variables from Regression on Full Sample with Panel Data for Year 1975, 1976, 1977, 1978, 1979 and 1980 (Number of observations = 77)

Dependent Variable = Savings rate (SAVGDP)	**Ageing Variables**	1975	1976	1977	1978	1979	1980
	Female fraction aged 65 or above, 1975-80	-*	-*	-	-*	-	-*
	Male fraction aged 65 or above, 1975-80	-	-	-	-*	-	-*
	Log (total life expectancy), 1967-72	-	-	-	+*	+*	+*
	Log (female life expectancy), 1967-72	-	-	-	+*	+*	+*
	Log (male life expectancy), 1967-72	-	-	-	+*	+*	+*
Dependent Variable = Investment ratio (INVGDP)	Female fraction aged 65 or above, 1975-80	-*	-*	-*	-*	-*	-*
	Male fraction aged 65 or above, 1975-80	-*	-*	-*	-*	-*	-*
	Log (total life expectancy), 1967-72	-	-	-	-	+*	+*
	Log (female life expectancy), 1967-72	-	-	-	-	+*	+*
	Log (male life expectancy), 1967-72	-	-	-	-	+*	+*

* represents that the estimated coefficient is statistical insignificance (If no * mark on, it means the coefficient is significance.)

+ represents estimated coefficient with a positive sign

- represents estimated coefficient with a negative sign

Table 5.9 Signs of Estimated Coefficients of Ageing variables from Regression on Non-Poor Countries Sample with Panel Data for Year 1975, 1976, 1977, 1978, 1979 and 1980 (Number of observations = 39)

Dependent Variable = Savings rate (SAVGDP)	**Ageing Variables**	1975	1976	1977	1978	1979	1980
	Female fraction aged 65 or above, 1975-80	-*	-*	-*	-*	-*	-*
	Male fraction aged 65 or above, 1975-80	-*	-*	-*	-*	-*	-*
	Log (total life expectancy), 1967-72	-	-	-	-	-*	-
	Log (female life expectancy), 1967-72	-	-	-	-*	-*	-*
	Log (male life expectancy), 1967-72	-	-	-	-	-*	-
Dependent Variable = Investment ratio (INVGDP)	Female fraction aged 65 or above, 1975-80	-*	-*	-*	-*	-*	-*
	Male fraction aged 65 or above, 1975-80	-*	-*	-*	-*	-*	-*
	Log (total life expectancy), 1967-72	-	-	-	-	+*	+
	Log (female life expectancy), 1967-72	-	-	-	-	+*	+
	Log (male life expectancy), 1967-72	-	-	-	-	+*	+*

* represents that the estimated coefficient is statistical insignificance (If no * mark on, it means the coefficient is significance.)

+ represents estimated coefficient with a positive sign

- represents estimated coefficient with a negative sign

Table 5.10 Regressions for Savings of Cross-sectional Data (Dependent Variable = INV7085; Number of Observations = 67)

	(C33)	(C34)	(C35)	(C36)	(C37)	(C38)	(C39)	(C40)	(C41)	(C42)
Constant	0.0787	0.0785	-0.0373	-0.0373	-0.0341	0.0794	0.0791	0.0266	-0.0035	0.0559
	(0.036)	(0.038)	(0.915)	(0.916)	(0.921)	(0.035)	(0.036)	(0.935)	(0.991)	(0.858)
Log (Per capita GDP at 1970)	0.0251	0.0243	0.0203	0.0200	0.0206	0.0252	0.0244	0.0214	0.0206	0.0220
	(0.086)	(0.092)	(0.174)	(0.190)	(0.158)	(0.080)	(0.085)	(0.153)	(0.179)	(0.131)
Primary school enrollment ratio at 1970	0.0715	0.0715	0.0693	0.0692	0.0695	0.0713	0.0713	0.0714	0.0703	0.0724
	(0.052)	(0.053)	(0.071)	(0.072)	(0.070)	(0.052)	(0.053)	(0.062)	(0.067)	(0.058)
Secondary school enrollment ratio at 1970	0.0837	0.0813	0.0615	0.0619	0.0614	0.0856	0.0838	0.0651	0.0630	0.0673
	(0.121)	(0.141)	(0.217)	(0.210)	(0.219)	(0.109)	(0.125)	(0.200)	(0.211)	(0.186)
Average government consumption ratio, 1970-85	0.0864	0.0896	0.0893	0.0895	0.0889	0.0870	0.0903	0.0864	0.0876	0.0855
	(0.408)	(0.395)	(0.397)	(0.396)	(0.399)	(0.405)	(0.390)	(0.411)	(0.405)	(0.415)
Average growth rate of terms of trade, 1970-85	-0.0939	-0.0966	-0.1076	-0.1081	-0.1072	-0.0901	-0.0935	-0.1103	-0.1102	-0.1107
	(0.513)	(0.504)	(0.443)	(0.440)	(0.444)	(0.532)	(0.517)	(0.430)	(0.430)	(0.429)
Average female fraction aged 65 or above, 1970-85	-0.0014									
	(0.625)									
Average male fraction aged 65 or above, 1970-85		-0.0016								
		(0.702)								
Log (Average total life expectancy), 1970-85			0.0290							
			(0.747)							
Log (Average female life expectancy), 1970-85				0.0288						
				(0.748)						
Log (Average male life expectancy), 1970-85					0.0284					
					(0.748)					
Female fraction aged 65 or above at 1970						-0.0017				
						(0.567)				
Male fraction aged 65 or above at 1970							-0.0020			
							(0.635)			
Log (Total life expectancy at birth in 1970)								0.0128		
								(0.880)		
Log (Female life expectancy at birth in 1970)									0.0205	
									(0.809)	
Log (Male life expectancy at birth in 1970)										0.0051
										(0.950)
Adjusted R^2	0.4759	0.4751	0.4747	0.4747	0.4747	0.4767	0.4758	0.4740	0.4743	0.4738
Estimate σ	0.0537	0.0538	0.0538	0.0538	0.0538	0.0537	0.0537	0.0538	0.0538	0.0538

Table 5.10 (Continued) Regressions for Savings of Cross-sectional Data (Dependent Variable = INV7085; Number of Observations = 67)

	(C43)	(C44)	(C45)	(C46)	(C47)	(C48)	(C49)	(C50)
Constant	-0.0159	-0.0298	0.0533	0.0417	-0.2765	-0.2922	-0.1271	-0.1309
	(0.964)	(0.933)	(0.872)	(0.899)	(0.503)	(0.481)	(0.728)	(0.722)
Log (Per capita GDP at 1970)	0.0232	0.0223	0.0246	0.0237	0.0328	0.0302	0.0337	0.0310
	(0.157)	(0.164)	(0.128)	(0.136)	(0.060)	(0.077)	(0.049)	(0.065)
Primary school enrollment ratio at 1970	0.0684	0.0680	0.0705	0.0701	0.0569	0.0562	0.0618	0.0617
	(0.077)	(0.080)	(0.068)	(0.070)	(0.139)	(0.147)	(0.106)	(0.109)
Secondary school enrollment ratio at 1970	0.0767	0.0739	0.0833	0.0807	0.0480	0.0437	0.0521	0.0478
	(0.204)	(0.222)	(0.171)	(0.189)	(0.441)	(0.485)	(0.412)	(0.457)
Average government consumption ratio, 1970-85	0.0899	0.0935	0.0878	0.0913	0.1011	0.1123	0.0977	0.1061
	(0.397)	(0.382)	(0.407)	(0.391)	(0.340)	(0.297)	(0.358)	(0.324)
Average growth rate of terms of trade, 1970-85	-0.0920	-0.0936	-0.0900	-0.0932	-0.0643	-0.0674	-0.0682	-0.0763
	(0.526)	(0.522)	(0.535)	(0.522)	(0.653)	(0.641)	(0.635)	(0.598)
Average female fraction aged 65 or above, 1970-85	-0.0013				-0.0039			
	(0.651)				(0.210)			
Average male fraction aged 65 or above, 1970-85		-0.0015				-0.0047		
		(0.712)				(0.289)		
Log (Average total life expectancy), 1970-85	0.0243	0.0279			0.0972	0.1011		
	(0.790)	(0.758)			(0.355)	(0.338)		
Female fraction aged 65 or above at 1970			-0.0017				-0.0041	
			(0.580)				(0.211)	
Male fraction aged 65 or above at 1970				-0.0020				-0.0046
				(0.645)				(0.310)
Log (Total life expectancy at birth in 1970)			0.0068	0.0098			0.0599	0.0605
			(0.936)	(0.909)			(0.527)	(0.524)
Sub-Saharan Africa					0.0111	0.0094	-0.0331	-0.0311
					(0.685)	(0.734)	(0.104)	(0.126)
Latin America					-0.0342	-0.0325	0.0067	0.0047
					(0.098)	(0.115)	(0.799)	(0.860)
Adjusted R^2	0.4677	0.4671	0.4679	0.4670	0.4886	0.4845	0.4849	0.4800
Estimate σ	0.0541	0.0542	0.0541	0.0542	0.0531	0.0533	0.0533	0.0535

Table 5.11 Results for Savings Rate with panel data for 67 countries from 1975-80 (Dependent Variable = SAVGDP; Number of observations = 402)

	(75)	(76)	(77)	(78)	(79)	(80)	(81)	(82)	(83)	(84)
Constant	-0.1927	-0.1674	1.1103	0.9207	1.1251	-0.1794	-0.1558	1.0735	0.9560	1.0808
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log (Per capita GDP)	0.0438	0.0471	0.0428	0.0345	0.0424					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
Log (Per capita GDP at 1975)						0.0375	0.0427	0.0396	0.0290	0.0386
						(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Primary school enrollment ratio	0.0016	0.0013	0.0023	0.0022	0.0023					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
Primary school enrollment ratio at 1975						0.0020	0.0016	0.0026	0.0026	0.0026
						(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Secondary school enrollment ratio	-0.0007	-0.0004	-0.0001	-0.0000	-0.0001					
	(0.001)	(0.043)	(0.545)	(0.911)	(0.428)					
Secondary school enrollment ratio at 1975						-0.0007	-0.0004	-0.0001	0.0001	-0.0001
						(0.014)	(0.072)	(0.744)	(0.610)	(0.670)
Government consumption ratio	-0.0417	-0.0360	-0.0717	-0.0795	-0.0632	-0.0494	-0.0444	-0.0780	-0.0893	-0.0707
	(0.002)	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Growth rate of terms of trade	0.0755	0.0746	0.0784	0.0779	0.0792	0.0702	0.0699	0.0726	0.0727	0.0730
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female fraction aged 65 or above, 1965-70	-0.0075					-0.0073				
	(0.000)					(0.000)				
Male fraction aged 65 or above, 1965-70		-0.0160					-0.0155			
		(0.000)					(0.000)			
Log (Total life expectancy), 1967-72			-0.3475					-0.3397		
			(0.000)					(0.000)		
Log (Female life expectancy), 1967-72				-0.2818					-0.2898	
				(0.000)					(0.000)	
Log (Male life expectancy), 1967-72					-0.3548					-0.3427
					(0.000)					(0.000)
Buse Raw-moment R^2	0.9838	0.9563	0.9670	0.9566	0.9692	0.9379	0.9695	0.9722	0.9433	0.9750
Estimate σ	0.9793	0.9811	0.9806	0.9827	0.9818	0.9726	0.9480	0.9740	0.9744	0.9754

Table 5.14 Results for Savings Rate with panel data for 33 non-poor countries from 1975-80 (Dependent Variable = SAVGDP; Number of observations = 198)

	(111)	(112)	(113)	(114)	(115)	(116)	(117)	(118)	(119)	(120)	(121)	(122)	(123)	(124)
Constant	0.0213	0.0579	0.2118	0.2279	-0.0671	-0.5803	-0.2536	-0.1061	-0.6273	-0.2173	-0.3549	-1.0452	-0.5590	-0.6703
	(0.755)	(0.373)	(0.002)	(0.001)	(0.903)	(0.147)	(0.603)	(0.801)	(0.082)	(0.573)	(0.504)	(0.006)	(0.151)	(0.104)
Log (Per capita GDP)	0.0202	0.0176	0.0055	0.0070	0.0075	0.0013	0.0054	0.0007	-0.0003	-0.0001	0.0192	0.0149	0.0071	0.0021
	(0.000)	(0.001)	(0.277)	(0.206)	(0.461)	(0.886)	(0.536)	(0.929)	(0.969)	(0.985)	(0.050)	(0.041)	(0.313)	(0.770)
Primary school enrollment ratio	0.0009	0.0007	0.0005	0.0004	0.0002	0.0004	0.0003	0.0003	0.0003	0.0004	0.0005	0.0005	0.0005	0.0002
	(0.020)	(0.041)	(0.146)	(0.203)	(0.629)	(0.371)	(0.417)	(0.494)	(0.523)	(0.345)	(0.150)	(0.163)	(0.200)	(0.594)
Secondary school enrollment ratio	0.0008	0.0009	0.0012	0.0012	0.0004	0.0002	0.0004	0.0005	0.0002	0.0005	0.0004	0.0003	0.0008	0.0008
	(0.000)	(0.000)	(0.000)	(0.000)	(0.132)	(0.479)	(0.096)	(0.041)	(0.547)	(0.031)	(0.042)	(0.218)	(0.000)	(0.000)
Government consumption ratio	-0.5023	-0.4927	-0.5808	-0.5760	-0.5216	-0.5356	-0.5214	-0.5590	-0.5995	-0.5685	-0.5391	-0.5206	-0.5402	-0.5680
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Growth rate of terms of trade	0.0799	0.0798	0.0783	0.0767	0.0826	0.0826	0.0835	0.0819	0.0831	0.0828	0.0798	0.0803	0.0758	0.0724
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female fraction aged 65 or above, 1965-70	-0.0041		-0.0045								-0.0049		-0.0056	
	(0.000)		(0.000)								(0.000)		(0.000)	
Male fraction aged 65 or above, 1965-70		-0.0066		-0.0080								-0.0085		-0.0104
		(0.000)		(0.000)								(0.000)		(0.000)
Log (total life expectancy), 1967-72					0.0619			0.0869			0.1088	0.1353	0.1833	0.2360
					(0.671)			(0.416)			(0.436)	(0.340)	(0.060)	(0.028)
Log (female life expectancy), 1967-72						0.1946			0.2201					
						(0.075)			(0.023)					
Log (male life expectancy), 1967-72							0.1074			0.1139				
							(0.401)			(0.236)				
Student-teacher ratio in primary school			-0.0007	-0.0009				-0.0002	-0.0004	-0.0003			-0.0003	-0.0008
			(0.045)	(0.011)				(0.569)	(0.387)	(0.542)			(0.489)	(0.043)
Student-teacher ratio in secondary school			-0.0008	-0.0006				-0.0008	-0.0009	-0.0009			-0.0007	-0.0003
			(0.004)	(0.026)				(0.014)	(0.016)	(0.007)			(0.032)	(0.255)
Buse Raw-moment R^2	0.9855	0.9846	0.9971	0.9981	0.9823	0.9746	0.9843	0.9830	0.9785	0.9842	0.9960	0.9946	0.9919	0.9952
Estimate σ	1.0064	1.0070	1.0021	1.0047	0.9876	0.9769	0.9922	0.9935	0.9765	0.9942	0.9970	0.9957	0.9999	1.0066

Table 5.15 Results for Savings Rate with panel data for 33 non-poor countries from 1975-80 (Dependent Variable = INVGDP; Number of observations = 198)

	(125)	(126)	(127)	(128)	(129)	(130)	(131)	(132)	(133)	(134)	(135)	(136)	(137)	(138)
Constant	0.2501	0.2959	0.4074	0.4409	-1.7669	-0.7393	-1.5426	-1.0928	-0.2631	-1.1968	-2.0111	-2.1597	-1.1571	-1.3713
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.051)	(0.000)	(0.003)	(0.461)	(0.000)	(0.000)	(0.000)	(0.012)	(0.004)
Log (Per capita GDP)	-0.0054	-0.0095	-0.0047	-0.0071	-0.0472	-0.0270	-0.0379	-0.0505	-0.0401	-0.0477	-0.0382	-0.0426	-0.0318	-0.0377
	(0.329)	(0.069)	(0.532)	(0.325)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)
Primary school enrollment ratio	0.0008	0.0006	0.0002	0.0000	-0.0004	0.0002	-0.0001	-0.0003	0.0000	-0.0001	0.0001	-0.0002	-0.0001	-0.0004
	(0.007)	(0.031)	(0.539)	(0.951)	(0.195)	(0.527)	(0.827)	(0.310)	(0.960)	(0.674)	(0.873)	(0.461)	(0.730)	(0.198)
Secondary school enrollment ratio	0.0005	0.0004	0.0001	0.0001	-0.0004	-0.0002	-0.0004	-0.0002	-0.0001	-0.0003	-0.0003	-0.0002	-0.0000	0.0000
	(0.067)	(0.111)	(0.750)	(0.647)	(0.106)	(0.363)	(0.145)	(0.436)	(0.503)	(0.217)	(0.274)	(0.391)	(0.874)	(0.910)
Government consumption ratio	-0.1691	-0.1420	-0.3124	-0.2505	-0.2478	-0.2730	-0.3279	-0.3807	-0.5053	-0.4184	-0.2754	-0.2174	-0.4012	-0.3549
	(0.010)	(0.044)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Growth rate of terms of trade	0.0289	0.0306	0.0343	0.0345	0.0251	0.0295	0.0245	0.0250	0.0323	0.02683	0.0243	0.0226	0.0300	0.0296
	(0.051)	(0.040)	(0.028)	(0.027)	(0.095)	(0.047)	(0.096)	(0.121)	(0.038)	(0.093)	(0.103)	(0.128)	(0.057)	(0.056)
Female fraction aged 65 or above, 1965-70	-0.0044		-0.0042								-0.0031		-0.0045	
	(0.000)		(0.000)								(0.014)		(0.001)	
Male fraction aged 65 or above, 1965-70		-0.0053		-0.0070								-0.0051		-0.0076
		(0.001)		(0.000)								(0.014)		(0.000)
Log (total life expectancy), 1967-72					0.5999			0.4590			-0.6350	0.6846	0.4399	0.5102
					(0.000)			(0.000)			(0.000)	(0.000)	(0.001)	(0.000)
Log (female life expectancy), 1967-72						0.2971			0.2426					
						(0.004)			(0.017)					
Log (male life expectancy), 1967-72							0.5272			0.4832				
							(0.000)			(0.000)				
Student-teacher ratio in primary school			-0.0010	-0.0009				-0.0012	-0.0023	-0.0013			-0.0010	-0.0009
			(0.054)	(0.088)				(0.022)	(0.000)	(0.008)			(0.077)	(0.130)
Student-teacher ratio in secondary school			-0.0015	-0.0017				-0.0012	-0.0012	-0.0014			-0.0015	-0.0018
			(0.000)	(0.000)				(0.006)	(0.002)	(0.001)			(0.000)	(0.000)
Buse Raw-moment R^2	0.9877	0.9853	0.9914	0.9903	0.9929	0.9835	0.9928	0.9863	0.9867	0.9854	0.9876	0.9908	0.9809	0.9868
Estimate σ	0.9944	0.9920	0.9748	0.9734	0.9821	0.9886	0.9812	0.9771	0.9741	0.9777	0.9862	0.9889	0.9785	0.9822

Table 5.16 Further Results for Growth Rate of Per Capita GDP with Cross-sectional Data (Dependent Variable = GR7085)

	(C72)	(C73)	(C74)	(C75)	(C76)	(C77)
No. of observations	91	91	91	91	44	44
Constant	-0.1902	-0.1751	-0.1343	-0.1307	0.1265	0.1797
	(0.028)	(0.043)	(0.148)	(0.163)	(0.588)	(0.475)
Per capita GDP at 1970	-0.0180	-0.0175	-0.0145	-0.0139	-0.0158	-0.0154
	(0.000)	(0.000)	(0.001)	(0.001)	(0.008)	(0.009)
Square of per capita GDP at 1970	0.0011	0.0011	0.0008	0.0008	0.0010	0.0010
	(0.011)	(0.012)	(0.043)	(0.052)	(0.058)	(0.060)
Primary school enrollment rate at 1970	0.0032	0.0045	0.0101	0.0106	0.0084	0.0131
	(0.741)	(0.644)	(0.271)	(0.250)	(0.686)	(0.527)
Secondary school enrollment rate at 1970	0.0046	0.0060	-0.0105	-0.0080		
	(0.779)	(0.715)	(0.494)	(0.605)		
Student-teacher ratio in primary school at 1970					-0.0009	-0.0009
					(0.022)	(0.028)
Average government consumption ratio, 1970-85	-0.1219	-0.1253	-0.1098	-0.1118	-0.0925	-0.0980
	(0.000)	(0.000)	(0.000)	(0.000)	(0.015)	(0.010)
Number of revolutions and coups, 1970-85	-0.0249	-0.0248	-0.0209	-0.0206	-0.0337	-0.0350
	(0.009)	(0.010)	(0.018)	(0.021)	(0.025)	(0.021)
Number of assassinations, 1970-85	-0.0013	-0.0015	-0.0018	-0.0019		
	(0.746)	(0.720)	(0.627)	(0.620)		
Average investment ratio, 1970-85	0.1287	0.1288	0.1144	0.1132	0.1517	0.1511
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Average female fraction aged 65 or above, 1970-85	0.0017		0.0012		0.0012	
	(0.028)		(0.116)		(0.172)	
Average male fraction aged 65 or above, 1970-85		0.0023		0.0013		0.0018
		(0.046)		(0.229)		(0.171)
Log (Average tot life expectancy), 1970-85	0.0552	0.0510	0.0431	0.0420	-0.0171	-0.0315
	(0.016)	(0.026)	(0.076)	(0.087)	(0.767)	(0.616)
Sub-Saharan Africa			-0.0174	-0.0168		
			(0.004)	(0.005)		
Latin America			-0.0181	-0.0185		
			(0.000)	(0.000)		
Adjusted R^2	0.4926	0.4875	0.5793	0.5737	0.5338	0.5339
Estimate σ	0.0163	0.0164	0.0148	0.0149	0.0149	0.0149

Table 5.17 Further Results for Growth Rate of Per Capita GDP with Panel Data for 77 countries from 1975 to 1980 (Dependent Variable = GRPCGDP; number of observations = 462)

	(139)	(140)	(141)	(142)	(143)	(144)	(145)	(146)
Constant	-0.3374	-0.3312	-0.2398	-0.2392	-0.4204	-0.4171	-0.3154	-0.3153
	(0.000)	(0.000)	(0.003)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)
Log (Per capita GDP)	-0.0088	-0.0086	-0.0053	-0.0053	-0.0086	-0.0082	-0.0045	-0.0045
	(0.000)	(0.000)	(0.053)	(0.043)	(0.000)	(0.000)	(0.093)	(0.080)
Primary school enrollment ratio	-0.0002	-0.0002	-0.0001	-0.0001	-0.0002	-0.0002	-0.0001	-0.0001
	(0.030)	(0.053)	(0.240)	(0.233)	(0.015)	(0.033)	(0.313)	(0.302)
Secondary school enrollment ratio	-0.0002	-0.0002	-0.0003	-0.0003	-0.0002	-0.0002	-0.0003	-0.0003
	(0.148)	(0.113)	(0.020)	(0.022)	(0.122)	(0.094)	(0.011)	(0.012)
Government consumption ratio, 1969-74	0.0054	0.0054	0.0015	0.0015	0.0081	0.0081	0.0040	0.0040
	(0.000)	(0.000)	(0.365)	(0.344)	(0.000)	(0.000)	(0.029)	(0.025)
Saving ratio	0.0741	0.0752	0.0708	0.0704				
	(0.000)	(0.000)	(0.000)	(0.000)				
Investment ratio					0.1050	0.1042	0.1016	0.1010
					(0.000)	(0.000)	(0.000)	(0.000)
Growth rate of terms of trade	0.0170	0.0168	0.0182	0.0182	0.0249	0.0250	0.0272	0.0271
	(0.031)	(0.033)	(0.023)	(0.024)	(0.001)	(0.001)	(0.001)	(0.001)
Female fraction aged 65 or above, 1965-70	0.0007		-0.0003		0.0007		-0.0002	
	(0.158)		(0.576)		(0.117)		(0.593)	
Male fraction aged 65 or above, 1965-70		0.0011		-0.0004		0.0011		-0.0004
		(0.129)		(0.598)		(0.135)		(0.550)
Log (Total life expectancy), 1967-72	0.1064	0.1039	0.0791	0.0792	0.1235	0.1216	0.0932	0.0934
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Sub-Saharan Africa			-0.0196	-0.0196			-0.0204	-0.0204
			(0.001)	(0.001)			(0.000)	(0.000)
Latin America			-0.0165	-0.0165			-0.0160	-0.0160
			(0.000)	(0.000)			(0.000)	(0.000)
Buse Raw-moment R^2	0.6288	0.6267	0.6035	0.6055	0.6380	0.6358	0.6062	0.6054
Estimate σ	0.9960	0.9954	0.9986	0.9980	0.9981	0.9979	1.0023	1.0013

Table 5.18 Further Results for Growth Rate of Per Capita GDP with Panel Data for 39 countries from 1975 to 1980 (Dependent Variable = GRPCGDP; number of observations = 234)

	(147)	(148)	(149)	(150)	(151)	(152)	(153)	(154)
Constant	0.1985	0.1998	-0.3825	-0.3545	0.1397	0.1401	-0.2653	-0.2309
	(0.000)	(0.000)	(0.025)	(0.040)	(0.013)	(0.013)	(0.169)	(0.217)
Log (Per capita GDP)	-0.0202	-0.0207	-0.0153	-0.0163	-0.0136	-0.0138	-0.0094	-0.0102
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.034)	(0.022)
Primary school enrollment ratio	-0.0005	-0.0005	-0.0005	-0.0005	-0.0004	-0.0004	-0.0005	-0.0005
	(0.160)	(0.138)	(0.092)	(0.087)	(0.233)	(0.214)	(0.150)	(0.146)
Secondary school enrollment ratio	0.0005	0.0004	-0.0000	-0.0001	0.0004	0.0004	-0.0000	-0.0000
	(0.004)	(0.010)	(0.822)	(0.727)	(0.010)	(0.023)	(1.000)	(0.980)
Student-teacher ratio in primary school	-0.0002	-0.0003	0.0000	-0.0000	0.0000	-0.0000	0.0002	0.0002
	(0.491)	(0.368)	(0.885)	(0.961)	(0.962)	(0.962)	(0.470)	(0.537)
Student-teacher ratio in secondary school	-0.0010	-0.0008	-0.0009	-0.0008	-0.0010	-0.0009	-0.0010	-0.0009
	(0.012)	(0.031)	(0.010)	(0.025)	(0.006)	(0.015)	(0.006)	(0.011)
Government consumption ratio, 1969-74	-0.0912	0.0985	0.0871	0.0897	0.0673	0.0694	0.0544	0.0534
	(0.009)	(0.004)	(0.008)	(0.006)	(0.050)	(0.049)	(0.107)	(0.115)
Saving ratio	0.1014	0.1025	0.1447	0.1446				
	(0.000)	(0.000)	(0.000)	(0.000)				
Investment ratio					0.0995	0.1005	0.1103	0.1121
					(0.000)	(0.000)	(0.000)	(0.000)
Growth rate of terms of trade	-0.0429	-0.0442	-0.0423	-0.0449	-0.0286	-0.0301	-0.0258	-0.0279
	(0.011)	(0.008)	(0.010)	(0.005)	(0.063)	(0.049)	(0.087)	(0.062)
Female fraction aged 65 or above, 1965-70	-0.0001		-0.0003		-0.0003		-0.0004	
	(0.915)		(0.657)		(0.674)		(0.462)	
Male fraction aged 65 or above, 1965-70		0.0007		0.0004		0.0002		-0.0001
		(0.457)		(0.639)		(0.841)		(0.883)
Log (Total life expectancy), 1967-72			0.1343	0.1287			0.0920	0.0872
			(0.001)	(0.002)			(0.037)	(0.053)
Buse Raw-moment R^2	0.6584	0.6770	0.7190	0.7323	0.6648	0.6658	0.6467	0.6411
Estimate σ	1.0003	0.9997	1.0093	1.0077	1.0049	1.0043	1.0086	1.0071

APPENDIX

Appendix 1: Means and Standard Deviations of Variables for Panel Data

	77-country sample 1975-80[15]		39-country sample 1975-80	
Variables	Mean	σ	Mean	σ
INVGDP	0.25364	0.11062	0.26054	0.084187
SAVGDP	0.20393	0.14049	0.24668	0.09881
PRIMARY	92.292	23.396	102.3	7.0947
SEC	46.700	28.877	66.258	23.899
STUTEPRI	32.012	13.021	24.424	9.4916
STUTESEC	22.330	10.422	18.845	8.456
LTOT	58.974	11.597	67.648	7.0046
LFEM	61.035	12.184	69.933	7.6091
LMAL	56.953	11.018	65.072	6.6332
LLTOT	4.0563	0.20796	4.2082	0.11514
LLFEM	4.0901	0.21058	4.2408	0.12008
LLMAL	4.0220	0.20538	4.1695	0.11326
FEMALE	6.2943	4.0017	9.0091	4.0079
MALE	4.9668	2.8640	6.8743	2.8886
PCGDP	4462.6	5610.9	8238.8	5758.2
LPCGDP	7.4511	1.4787	8.6952	0.86895
GRPCGDP	0.021503	0.052695	0.024578	0.05313
AVANGDP	4.0679	5.4497	3.8425	5.4974
GRTRADE	-0.0006268	0.15535	0.00015187	0.10927
GOVGDP	0.21834	0.40366	0.17263	0.065431
GOV6974	0.21363	0.43183	0.16792	0.088092

[15] The observations of all variables are drawn from 1975 to 1980 except the observations of FEMALE and MALE are drawn from 1965 to 1970 and the observations for all life expectancy variables which are drawn from 1967 to 1972.

Appendix 2: Means and Standard Deviations of Variables for Cross-sectional Data

	91-country sample 1970-85		44-country sample 1970-85	
Variables	Mean	σ	Mean	σ
HSINV	0.19722	0.078717	0.24008	0.066437
GDP70	2.8361	2.5666	4.5363	2.4686
SEC70	0.35912	0.26388	0.54068	0.23098
PRI70	0.87659	0.27108	1.0039	0.13803
GOV7085	0.17557	0.065614	0.17274	0.068273
REVCOUP	0.18319	0.23583	0.11568	0.19904
ASSASS	0.2367	0.47644	0.31636	0.61512
FEM7085	6.6958	4.7564	9.4553	5.0306
MAL7085	5.2268	3.2567	7.1671	3.4284
LTOT7085	61.066	10.911	69.108	5.6649
LFEM7085	63.256	11.645	71.896	6.0406
LMAL7085	58.98	10.258	66.452	5.3867
LLTOT	4.0951	0.18824	4.2322	0.085687
LLFEM	4.1293	0.1938	4.2716	0.087947
LLMAL	4.0612	0.18354	4.1931	0.084693
GR7085	0.016073	0.022849	0.019262	0.021761
PRI60	0.80099	0.31252	0.99841	0.19768
SEC60	0.23637	0.21741	0.38432	0.21396
POP7085	28.454	74.787	24.096	41.625
STPRI70	-	-	28.603	8.1053
STPRI65	-	-	29.489	8.7527
STSEC70	-	-	18.943	6.8713
STSEC65	-	-	18.598	5.7509

Appendix 3: Definitions of Variables in Appendix 1 and 2 (see World Bank World Table (1995) and Barro and Wolf (1989) for details)

Variables from Panel Data:

Variables	Definitions
INVGDP	Ratio of real domestic investment to real GDP from 1975 to 1980.
SAVGDP	Ratio of real domestic savings to real GDP from 1975 to 1980.
PRIMARY	Primary-school enrollment rate from 1975 to 1980.
SEC	Secondary-school enrollment rate from 1975 to 1980.
STUTEPRI (STUTESEC)	Student-teacher ratio in primary (secondary) schools from 1975 to 1980.
LTOT (LLTOT)	(Log of) total life expectancy at birth from 1967 to 1972.
LFEM (LLFEM)	(Log of) life expectancy at birth for female from 1967 to 1972.
LMAL (LLMAL)	(Log of) life expectancy at birth for male from 1967 to 1972.
FEMALE (MALE)	Percentage of female (male) population aged 65 or over from 1965 to 1970.
PCGDP (LPCGDP)	(Log of) value of per capita GDP from 1975 to 1980.
GRPCGDP	Growth rate of real per capita GDP from 1975 to 1980.
GRTRADE	Growth rate of terms of trade from 1975 to 1980.
GOVGDP (GCG6974)	Ratio of real government consumption to real GDP from 1975 to 1980 (from 1969 to 1974).

Notes.(i) Values of investment, savings, government consumption and GDP are measured in market prices at constant 1987 US dollars.

(ii) Enrollment ratios for primary school and secondary school are measured in percentage.

(iii) Terms of trade index are measured with 1987=100.

Appendix 3 (Continued): Definitions of Variables in Appendix 1 and 2 (see World Bank World Table (1995) and Barro and Wolf (1989) for details)

Variables from Cross-sectional Data:

Variables	Definitions
HSINV	Average from 1970 to 1985 of the ratio of real domestic investment to real GDP.
GDP70	1970 value of real per capita GDP (1980 base year).
SEC70 (SEC60)	1970 (1960) secondary school enrollment rate.
PRI70 (PRI60)	1970 (1960) primary school enrollment rate.
GOV7085	Average from 1970 to 1985 of the ratio of real government consumption to real GDP.
REVCOUP	Number of revolutions and coups per year (1970-85).
ASSASS	Number of assassinations per million population per year (1970-85).
FEM7085 (MAL7085)	Average from 1970 to 1985 of the female (male) population aged 65 or over.
LTOT7085 (LFEM7085, LMAL7085)	Average from 1970 to 1985 of the total (female, male) life expectancy at birth.
LLTOT (LLFEM, LLMAL)	Log of LTOT7085 (LFEM7085, LMAL7085).
GR7085	Growth rate of real per capita GDP from 1970 to 1985.
POP7085	Population in millions (geometric average of values from 1970 to 1985).
STPRI70 (STPRI65)	Student-teacher ratio in primary schools in 1970 (1965).
STSEC70 (STSEC65)	Student-teacher ratio in secondary schools in 1970 (1965).

Appendix 4: List of Countries in Samples

	Panel Data Samples		Cross-sectional Data Samples	
Country	77	39	91	44
Algeria			*	*
Argentina				
Australia				
Austria				
Bangladesh		*		*
Barbados	*	*		*
Belgium				
Benin		*	*	*
Bolivia		*		*
Botswana	*	*		*
Brazil				
Burundi		*		*
Cameroon	*	*		*
Canada				
Central African		*	*	*
Chile		*		
China		*	*	*
Colombia		*	*	*
Congo		*	*	*
Costa Rica				
Cyprus	*	*		
Denmark				
Dominican Republic		*		*
Ecudaor	*	*		
Egypt		*		*
El Salvador		*		
Ethopia	*	*		*
Fiji	*	*		*
Finland				
France				
Gabon				*
Gambia		*	*	*
Germany				
Ghana		*		*
Greece				
Guatemala		*		
Guyana		*		
Haiti		*		*
Honduras		*		*
Hong Kong				*
Iceland				
India		*		*
Indonesia		*		*

Iran	*	*		
Ireland				
Isreal				
Italy				
Jamaica				
Japan				
Jordan	*	*		*
Korea				*
Liberia	*	*		*
Luxembourg	*	*		*
Madagascar		*		*
Malawi		*		*
Malaysia				
Malta				
Mauritania		*	*	*
Mauritius		*		
Mexico				
Morocco	*	*		*
Myanmar		*	*	*
Nepal	*	*		*
Netherlands				
New Zealand				
Nicaragua				
Niger		*	*	*
Nigeria		*		*
Norway				
Pakistan		*		*
Panama				
Papua New Guinea	*	*		*
Paraguay		*		*
Peru		*		*
Phillipines		*		*
Portugal				
Rwanda		*		*
Senegal		*		*
Sierra Leone	*	*		*
Singapore	*	*		
South Africa				*
Spain				*
Sri Lanka		*		*
Sudan	*	*		*
Swaziland	*	*		*
Sweden				
Switzerland				
Tanzania	*	*		*
Thailand		*		*
Togo		*		*
Trinidad and Tobago				

Tunesia	*	*		*
Turkey		*		
Uganda	*	*		*
United Kingom				
United States				
Uruguay				
Venezuela	*	*		
Zaire	*	*		*
Zambia		*		*
Zimbabwe	*	*		*

* represents country absent in the sample

Figure 7: Relationship between Savings Rate and Fraction of Aged Population
from 1960-1993 in United States (World Bank Data)

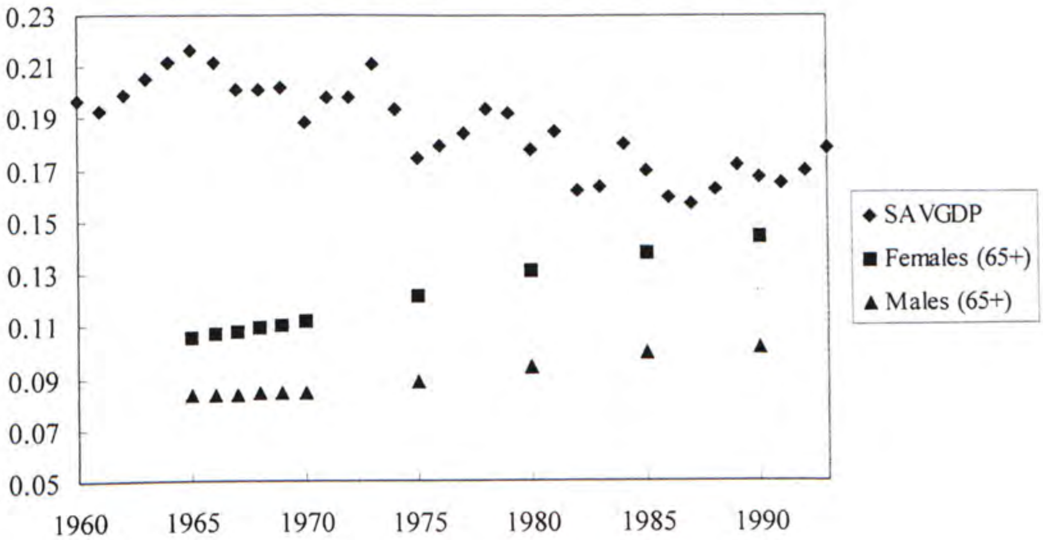
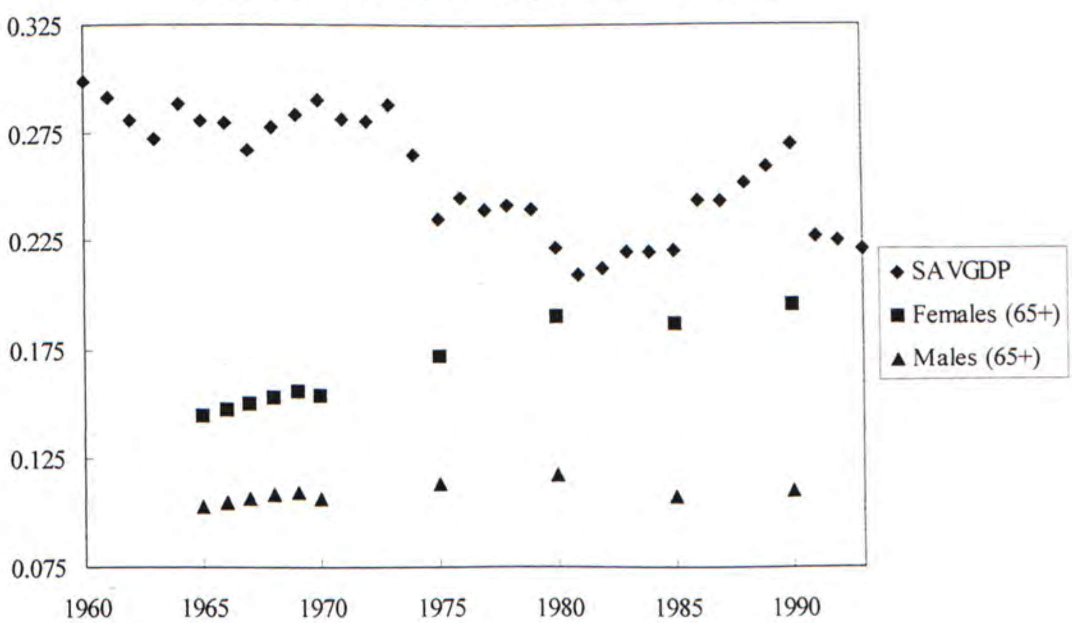


Figure 8: Relationship between Savings Rate and Fraction of Aged Population
from 1960-1993 in Germany (World Bank Data)



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